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ABSTRACT

Each of the 18 units in this collection addresses a different environmental problem. An introduction precedes the collection of activities and appendices provide lists of forest animals and plants and lists of food webs. A glossary is provided as is a bibliography. Each unit includes: (1) a list of objectives; (2) a summary; (3) a discussion of advance preparations including lists of materials; (4) teaching suggestions; (5) procedures; (6) alternative methods; and (7) suggestions for further activities involving various subject areas where appropriate. (RE)

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First Steps In Ecology

A GUIDE FOR THE ELEMENTARY GRADES

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INTRODUCTION

The Universe is but the Thing of things,
The things but balls all going round in rings.
Some of them mighty huge, some mighty tiny,
All of them radiant and mighty shiny.

Robert Frost

OUR PURPOSE

We came to this project with different backgrounds, experiences, and beliefs. Despite our differences, however, we are united in a common purpose: to help make this world a more harmonious and beautiful place in which to live.

Given an idealistic purpose, we chose a practical way to implement what we wish to achieve — we developed a classroom curriculum for the elementary grades, than taught this curriculum in seven pilot schools in Berkeley, California. This guide is the result of a year of intensive effort and experimentation.

Each unit in this guide attempts to deal with a different environmental problem. The method is participatory for both teacher and student(s). Our purpose is not to preach, nor is it to teach solutions, for there are no pat solutions to most problems. Instead, we hope to increase awareness of critical environmental issues, and promote understanding of man's role in the universe and his dependence upon other living things. In addition, this curriculum explores the feasibility of alternative patterns of use and consumption.

School children today are the citizens of tomorrow. We believe that Spaceship Earth can be a healthy, sane environment for all living things, but it involves tremendous effort and understanding on the part of today's citizens as well as those of tomorrow.

HOW TO USE THIS GUIDE

The units in this guide were carried out in twenty-five K-3 classrooms in Berkeley, California. With some modification most of the units are applicable to grades K-6. In some units such as **Food Web**, suggested alternatives make the more advanced project feasible for younger children. Alternatives are not always included, but with some imagination, the units can work for all elementary grades. The lessons do not necessarily have to be done in order and individual ones may be selected at random.

In certain instances, the teacher may wish to do a demonstration (i.e. water filtration from **Pollution** project) instead of having the entire class participate. In projects where small group activities are indicated (i.e. **Energy**), having all the students carry out one experiment may be preferable. Many projects may be done over a period of days, or even weeks. It may be helpful in some cases to solicit the aid of a parent or volunteer to assist the teacher in carrying out the activity. Several Berkeley classrooms did the Magic Boxes during the holiday season, (see **Toys**) and this proved to be a most enjoyable experience.

Discussion questions, from **Teaching Suggestions/Introduction**, follow a logical sequence. However, the teacher may choose to extract certain questions or vary her approach in other ways to suit the needs of her class. We urge teachers to use the **Background Information** in conjunction with the lessons although it is not intended for student use. It should serve as a useful tool to help the teacher understand the material involved in each unit.

The *Ecology Notebook* may be used in various ways. It can serve as an ongoing journal for each student or as an enrichment activity for individual students who wish to pursue subjects of particular interest. The notebooks provide continuity to the projects.

In conclusion, this guide may be used in various ways according to the prerogative of the teacher and depending upon the resources available to the school and community. The lessons in this guide proved to be a very successful educational tool in Berkeley, and we hope it will be valuable for use in many other classrooms. We hope teachers will enjoy these projects as much as we did.

Natural Resources

Objective
To create an awareness of the natural origins of many products and to stress the limited availability of some natural resources.

Summary
Each child enters an imaginary machine as a natural resource and emerges as a man-made product. The products which emerge are divided into the following resource groups — mineral/oil, mineral/-rock, plant and animal — for the purpose of class discussion.

Key Words
fossil fuel mineral natural resource
petroleum recycle

Advance Preparation
MATERIALS
large sheet
4 chairs
large bag
4 signs, one for each of the resources:
Plant, Animal, Mineral/Rock, Mineral/Oil
(Illustrate signs for younger children)
about 25 common household items, 1 per child

EXAMPLES:

Animal	
wool fabric	fur cap
leather shoe	wool sweater

Mineral/Oil	Mineral/Rock	Plant
plastic plate	ceramic plate	paper plate
plastic doll	glass jar	cotton doll
polyester fabric	tin can	cotton washcloth
synthetic cord	scissors	natural twine
tooth brush	fork	pencil
soap	toy metal car	newspaper
orlon sweater		

Teaching Suggestions
INTRODUCTION
Have you ever wondered what it would be like to live on a spaceship? Did you know that we are all on a spaceship right now? What is its name? *Spaceship Earth — emphasize that, like any other spaceship, our Earth has everything on it that we need for survival.* Can anyone think of something we all must have everyday in order to live? *Sun, water, air, soil — these are natural resources. They are the kind that we use in their natural form, ie. we do not convert them to manufactured products, but use them just as we find them in nature.* What other natural resources do we use in making clothes, cars, furniture, toys, food, etc.? *Mineral/rock (metals), mineral/oil (petroleum made from plants and animals that died millions of years ago), plants, animals.*

PROCEDURE
- Using the signs, set up four stations around the classroom.
- Set up the machine by draping a sheet over four chairs, two on each side with a crawl space between (see diagram).

• Choose two children to play the roles of electricity and gas. When a child enters the machine they will make machine — like noises until the child emerges (see diagram).
• Each child now plays the part of one of the four designated natural resources. As the child comes to the back of the machine, the teacher announces the resource the child will be and hands her a finished product, hidden from the class, made from that resource. (Example: Sonia is a barrel of oil.) She then crawls through the machine and comes out holding her finished product. (Example: Sonia says "I went in as a barrel of oil and came out as a plastic toothbrush.")
• The child deposits her product at the appropriate station.
• After every child has gone through the machine, have a discussion using the following questions as a guideline: Where does oil come from? *Dead plants and animals that have been turned into oil by heat and pressure over millions of years.* Can we grow more oil? *No.* If you buried a plastic doll, would it go back to oil? *No.* Can we grow more trees? Animals? Minerals (metals)? What can we do to avoid using up all our natural resources? *Recycle and reuse, cut down on disposables, walk and ride bikes instead of riding in cars.*

Background Information

Our planet earth is like a spaceship equipped with everything we need for survival. Our needs are met by transforming natural resources into products that we use. These natural resources are sun, air, water, soil, plants, animals and minerals. They fall into two categories — *renewable* and

nonrenewable resources.

Renewable resources include all plant and animal life. Natural energy sources such as sun, wind and water are classified as renewable even though they are inexhaustible. Living things are renewed in nature relatively quickly. However, sometimes man's demand for these resources may exceed nature's ability to resupply them.

Minerals such as coal, petroleum, rocks and metallic ores are nonrenewable. Man removes them from the earth much faster than nature can form them. We are using up the nonrenewable resources at a very rapid rate, especially petroleum. Current petroleum resources in the United States may last another thirty or so years at the present rate of consumption. Even if the supply lasts 100 — 200 more years, we must still find an alternative for this resource. Not only does petroleum provide fuel and energy for our cars, homes and industries, it is also used in making products as diverse as car tires, toothbrushes, detergents, plastic bags, fertilizers, panty hose, styrofoam cups, synthetic fabrics and other plastics. These products are usually not *biodegradable*, that is, they cannot be broken down by their environment into reusable components nor can most of these be remanufactured into new products.

Other minerals, such as copper, are fast disappearing too and cannot be replaced. Products made from rocks (including clay, sand, and metals) can't be returned to the earth although some glass and metal can be recycled.

Plants are our major food source. They also provide materials for products such as lumber, paper and cloth. Animals are used for food as well as for wool, leather, etc. Some paper products can be recycled and anything made from plants or animals will eventually return to the earth through the decomposition process.

Conservation of our resources, both limited and renewable, is necessary for man's continued survival. The rate of use should depend upon man's needs and nature's ability to meet them. We should decrease our demand for products made from resources that took millions of years to form, and harness the continuing power of the sun, wind and water to meet our future energy needs. Man must try to achieve a balance with his environment and treat the earth and its resources with respect.

More on Natural Resources

Math/Science

Do an experiment to see if the whole class can live on two gallons of water for the day. Fill two gallon jugs and use this for your water supply for the day.

Language Arts

MIME — Examples:

- One child plays a saw, several others portray trees. The trees fall into the saw and become newspapers which lie out flat with pages (arms) turning. The newspapers curl up and flatten out to indicate recycling.
- One child is a hammer, others are rocks. The hammer moves up and down as the rocks go through. They crumble, shake and become products such as bikes and typewriters. The man-made products operate for a short-time, then break down.
- Several children are oil, flowing along the floor. Others are cars which putter up to the pump to be filled up. Some of the oil becomes dolls.

Tell a story naming various products. (For example: We wake up every morning to the sound of our *alarm clocks*. Then we throw off our *covers* and get up.) Students write *italicized* items in the appropriate column on lists they have prepared with the following headings: **Plant, Animal, Mineral/Oil, Mineral/Rock**. This activity can be done in teams, then papers exchanged for correction.

Art

Children can cut out pictures of man-made objects from magazines or draw an object and then paste it

on a chart under the appropriate heading.

Animal	**Mineral/Rock**
wool sweater	lunch pail
leather shoe	ceramic cup
Mineral/Oil	**Plant**
plastic bag	paper bag
plastic doll	cotton shirt
comb	wood chair

Group Activity

True or False — Two equal teams line up facing each other about 15 feet apart. Each has a goal line 10 feet behind. One team is named true, the other false. One leader (teacher) calls out statements about natural resources. If what is called out is false, then the false team runs forward and the true team runs back to its goal line. The false players try to catch the true players before they get to their goal line. If the statement is true, then the true team chases the false team to its goal line. Players who are caught become members of the other team. The team that ends the game with the most players wins.

Example questions:

A metal car is made of plant — (F).
A can is oil — (F).
A plastic comb is oil — (T).

Discussion

During show and tell time have the children identify which resource or resources have been used to make the object they're sharing.

Do we need to conserve air, water, and sun? Would the Earth be a better place to live if it were made of solid gold?

Have children look in their lunches and discuss which natural resources are used. Or have them write a list. For example: lunch pail — rocks; plastic bag — oil; meat, eggs, cheese — animal; etc. If the children eat in the cafeteria have them discuss both the food and what it is served on.

Relay Race — Have students fill two bags with classroom objects — pencils, toys, paper, chalk, etc. Divide the class into two equal teams and place a bag in front of each team. Label two sets of tags with the natural resources — mineral/rock, mineral/oil, plant and animal. Place a set at the goal line opposite each team. At the signal the first player from each team must grab one item from the bag, run to his goal line, place his object in the correct resource pile and return to tag the next team runner. Example: paper plate to plant pile, plastic car to oil pile, etc. Each runner must wait to remove an object from the bag until he has been tagged by his returning team member. The class then goes over to the goal line and discusses in a group whether every object is in the correct resource pile.

Sitting in a circle, children tell a continuous story. Each stops when he has named a product (for example: "A little boy named Ted jumped on his *bike*..."). The next child names the natural resource from which the product is made and then continues the story.

Ecology Notebook

Creative Writing Exercise

Which takes up more space? *A plant, a pain.* Why? Which weighs more? *The sun's rays, a cloud.* Why? Which is louder? *A tree growing, the sun shining.* Which is heavier? *A mountain, an ocean.* What animal is like a rock? What insect is like a plant? What natural resource are you like? Why are you like that resource?

Imagine you are oil buried for thousands of years in rocks. What does it feel like to be pulled out of the rocks? What does the drill sound like? What does it feel like to be sucked up into the well and then made into something at the factory?

What does it feel like to be a newspaper that's already been read?

Imagine you are the first daffodil to come up in spring. How does it feel to break through the ground?

Write a story called, "My life as a rock, plant, animal or barrel of oil".

Newspaper Recycling

Objective
To show how and why paper is recycled.

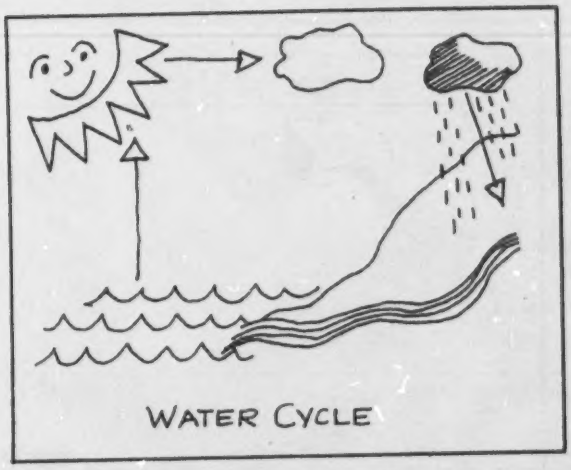
Summary
Each child makes a sheet of recycled paper by grinding newspaper into pulp, which is then screened and dried.

Key Words
cycle de-ink pulp recycle

Advance Preparation
MATERIALS
blender
2 pieces of window screen, 6"x6" with edges turned under
pan, 6"x8"x2", or larger
piece of wood larger than screen (small kitchen cutting board is ideal)
large stack of newspapers

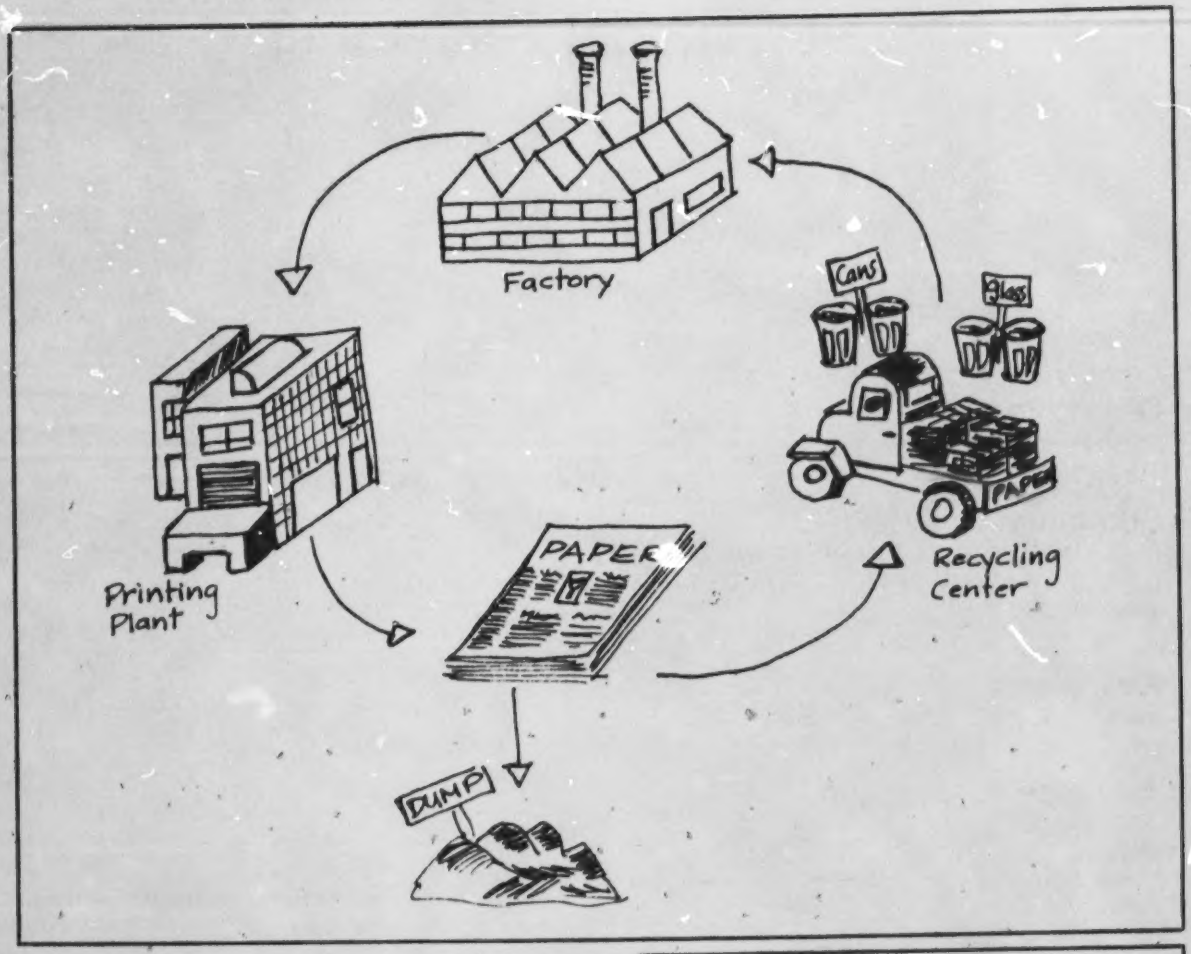
Set up a working area (newspaper recycling station) with water available.

Teaching Suggestions
INTRODUCTION
What are some words with *cycle* in them? *Bicycle, motorcycle, etc.* What does the word cycle mean? *Bi — cycle means two wheels. A cycle is a wheel that has no beginning and no end.*
Does anyone know what a water cycle is? *Clouds — rain — ocean — sun-evaporation — clouds.*



What does *re-cycle* mean? *To make or use again.* Why do we re-cycle paper? *To save trees.* How is paper recycled?

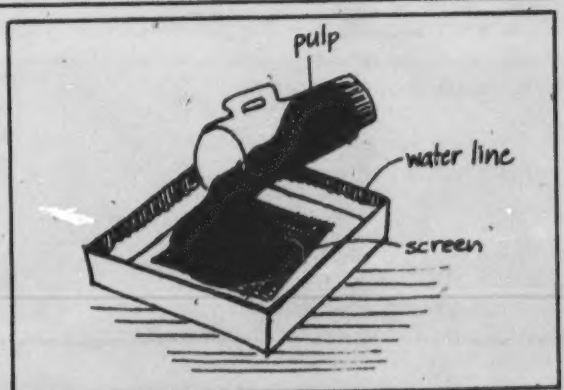
Commercial Paper Recycling Process
- Used paper is collected, sorted and delivered to the paper mill.
- It may be de-inked. This process includes removal of coatings, ink, glue and staples.
- The paper is beaten to a pulp which is cooked in water and acids and stirred.
- It is pumped onto gently vibrating screens which level it to a flat mass.
- It is passed through a series of rollers which squeeze and dry it.
- The paper is wound into huge rolls and transported to printers and manufacturers of paper products.



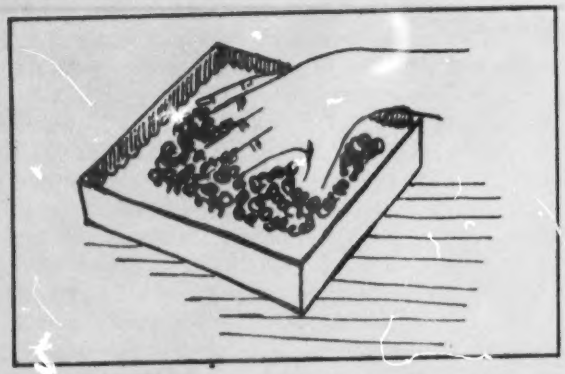
If paper is recycled it is not burned, dumped or used in landfills.

PROCEDURE

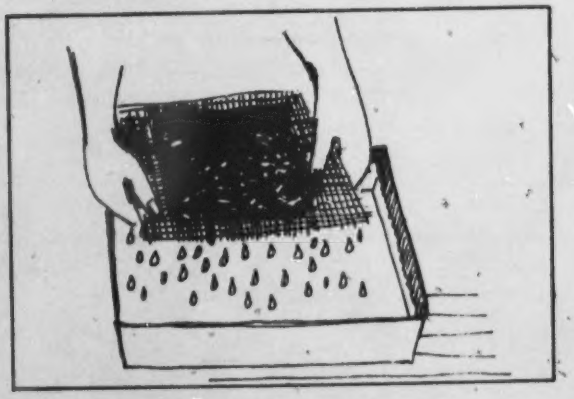
- Explain to the children that they will make a piece of recycled paper in much the same way it is done commercially.
- Send only five children at a time to the newspaper recycling station, while others are working independently at their desks.
- Give each child ½ of a single page of newspaper and tell them to tear it up into small pieces.
- Have all five drop their torn paper into the blender. Add water to the five cup line. Cover and blend paper until it is pulp.



- Pour approximately 1" of water into pan. Put screen in water and pour 1 cup of pulp over screen.

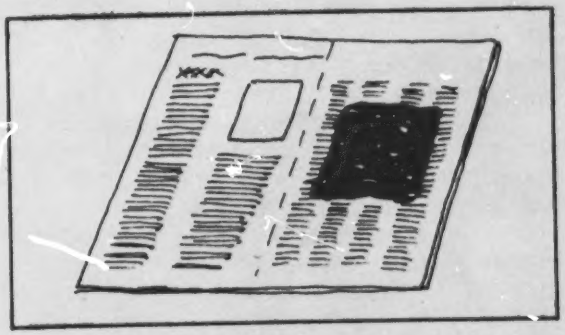


• Gently agitate the mixture with your fingers to distribute the pulp evenly in the water.



• Lift screen and let water drain.

• Insert screen with pulp into folded newspaper section. Carefully flip over newspaper section so that screen is on top of pulp. *This step is very important.*



• Place board on top of folded newspaper and press to squeeze out excess water. Unfold newspaper and remove screen.
• Leave recycled paper on newspaper and set aside to dry for approximately 24 hours.
• Repeat steps above with each of the remaining four children in the group.
• Repeat the entire process with a new group of five children.
• When recycled paper is thoroughly dry, carefully peel from the newspaper.
• Use the recycled paper for an art or writing project.

Background Information

Disposal of solid waste is becoming an increasing problem. Approximately a ton of trash per year is discarded by every American. This amount has to be reduced and better methods of disposing of it have to be found. Today, the main method of disposal is putting trash in open dumps which are unsightly and odorous. Available space for such dumping is also becoming scarce. The next most common method is incineration or burning which does reduce the volume, but creates air pollution in the process. Glass and metals don't burn, and they account for a large amount of our waste. Refuse is also used in sanitary landfills where it is compacted and put between layers of soil; this land is later used for recreational or other purposes. A very small amount of waste is salvaged and remanufactured, while even less is

composted.

Packaging materials, most frequently used for food, paper, wood, glass, metals and plastics, form the major sources of residential waste. Disposable convenience items, such as beverage containers, make up the bulk of litter on beaches, in parks and along highways.

There are alternatives to open dumps and we can cut down on the amount of waste which we create. Reusing things is the most efficient way of doing this. Returnable, reusable bottles can be refilled approximately 19 times and use only one-third of the energy used in remanufacturing new bottles. Paper and plastic bags can be used many times and throwaway containers can be reused for other purposes. Wood and fabrics can be used over again for both useful and artistic purposes. Another way of reducing waste is to cut down on our consumption of disposable items. We can also select more efficiently packaged products when we shop. Any organic waste can be composted instead of being dumped and some cities now have municipal compost piles.

Recycling is still a fairly expensive process, but it presents another possible solution to the one way drain of our natural resources and to the problem of where to put our garbage. Presently, much more industrial waste than home waste is recycled, but more and more recycling centers that collect paper, cans and glass are appearing. To recycle glass, it must be sorted by color, cleaned and crushed. The crushed glass is added to glass sand to speed up the melting process necessary for new glass production. Aluminum cans are remelted and used as a lower grade of aluminum. Bimetal cans, steel coated with tin, can be reused to make cheap metallic goods or in processing copper. Paper can also be recycled to make new paper, egg cartons, construction materials, etc., and more paper is recycled than any other material. However, not all glass, metal and paper can be recycled at this time.

Plastics still present a problem. Their use in packaging has more than doubled in the last ten years and there is no effective method of getting rid of them. Plastics cannot be recycled and they take ions to decompose. They also release poisonous gases when burned.

The cost of collecting and getting rid of garbage is increasing every year. Whatever the solutions are, reusing, recycling, composting, and/or using less, we have to remember that everything that is thrown away remains in one form or another on this earth forever.

More on Recycling

Math/Science

Take a poll in your class or neighborhood to find out how many families recycle. Chart your results.

Language Arts

Make a bulletin board for the hallway or principal's office. In the center design a recycling wheel which names and illustrates the recycling steps: Paper is 1) collected and sorted; 2) delivered to paper mill; 3) beaten into pulp; 4) rolled on a screen; 5) dried by heated rollers; 6) made into new paper or cardboard. Surround the wheel with examples of students recycled paper.

Get a book on Origami (paper folding). Make shapes from scrap paper.

Art

Make rubbings from leaves, bark or other objects found outdoors. Place white paper over the object and rub with the side of a crayon. Different colors on the same sheet create an interesting effect. Decorate garbage cans on the playground to encourage their use.

Group Activity

Invite a recycling center to arrange a pick-up day at your school. Organize a publicity campaign to inform the school.

Discussion

How can you cut down on your use of paper?

Reuse paper bags, use cloth napkins, etc.

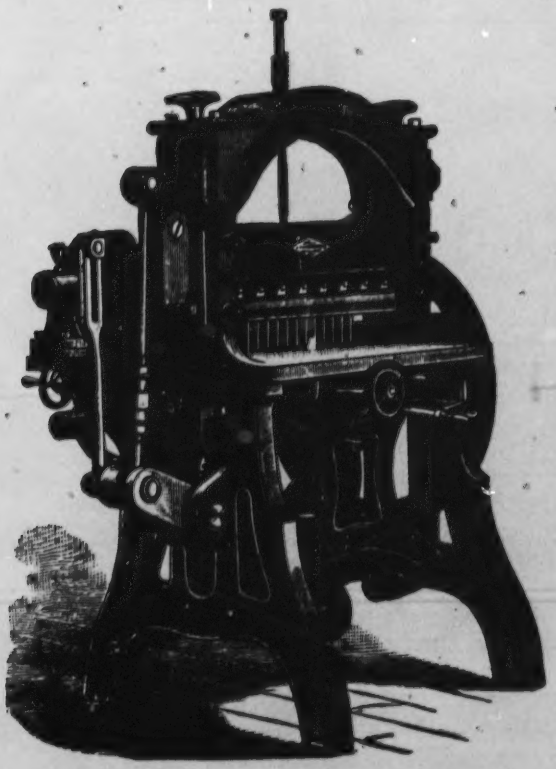
Ecology Notebook

Adopt a tree near the school.

- Pick a tree and identify it.
- Make a sketch of the tree.
- Press its spring, summer and fall leaves.
- Collect a winter bud.
- Take a picture of the tree.
- Note animals or birds that make their homes in the tree.
- Record the height of the tree in winter, spring.
- Keep a diary of tree — when new leaves start growing, tree visitors, plants growing on tree, first flowers, etc.

Paint a picture on your recycled paper.

Write the steps for making recycled paper on the piece of paper you made.

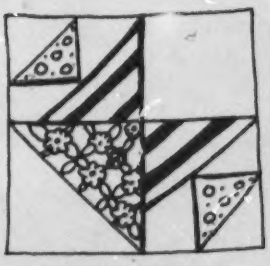


Friendship Quilt

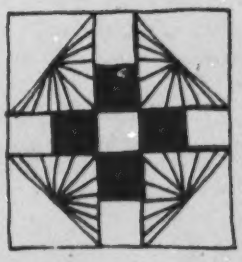
Objective
To demonstrate recycling by using fabric scraps or old clothing which would otherwise be discarded.

Summary
Each child designs and makes a fabric square. The squares are then put together to make a class quilt.

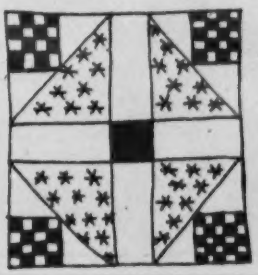
Advance Preparation
MATERIALS
fabric
scissors
white glue (diluted)
large piece of heavy cardboard, approximately 40"x48" (ruled into 30 squares, 8"x8")
pictures or samples of quilt patterns you have made (see diagram)
optional — *The Standard Book of Quilt Making and Collecting* by Marguerite Ickis



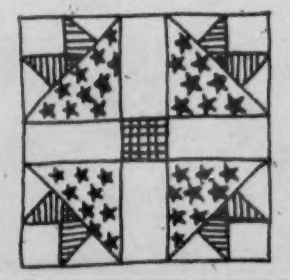
Cactus Flower



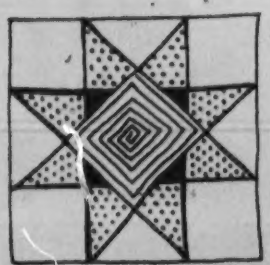
Churn Dash



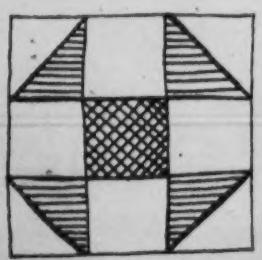
Grandmother's Choice



Goose Tracks or Cross and Crown



Lone Star



Puss in the Corner

Teaching Suggestions
INTRODUCTION
Did you know your great-great-grandparents were recyclers? Can you think of ways they recycled? *Hand-me-down clothes, quilts.* Review the history of quilting: original quilts were used for warmth and were filled with wool, feathers, moss

and grass. American pioneers could not buy cloth so they used scraps from mother's "going-to-meeting" dress, grandmother's wedding dress, or father's Revolutionary War uniform. In fact, you could say that quilts in those days were like today's photo albums. They recorded both hapiness and hardships of frontier life.

There are many superstitions surrounding quilting. Some people believed that quilts should be absolutely perfect while others felt that a perfect quilt was an insult to God. One pattern called *Wandering Foot* was avoided by many women for fear that it would send their sons far from home. But when the same pattern was renamed *Turkey Tracks*, it became harmless and popular.

PROCEDURE

- Show children examples of quilt patterns.
- Have each child cut out an 8"x8" backing square of solid colored fabric.
- Next have them cut out geometric shapes if copying a traditional pattern, or other interesting shapes if inventing their own. These pieces should contrast with the backing squares.
- Finally, have them glue their designs onto the backing squares. (Warning — Use glue sparingly as it may stain the cloth.) Have them glue their finished squares onto the large cardboard. (Extra spaces may be filled with plain fabrics.)
- Suggest that each child name the pattern he has created.

ALTERNATE METHOD

Children can sew their designs onto their 8"x8" squares, then sew the squares together.

More on Quilting

Math/Science

Using ¼ inch graph paper, have students design geometric quilt motifs which measure 4" on each side. Color them with magic markers. Collect the squares and display on a large piece of posterboard.

Language Arts

Write a report on the history of quilting and/or illustrate some of the quilts studied.

Art

Find a natural dye recipe for a color you like. Make the dye and batik or tie-dye a piece of cloth.

Make a braided rug from used or scrap fabrics.

Paint a large animal on butcher paper (at least 1½ feet high). Cut out and trace the animal on a second piece of butcher paper. Paint on the outside. Take the two pieces of paper and staple the edges together, stuffing the animal with crumpled newspaper.

Group Activity

Make a bookbag out of two squares of scrap material. Sew shoulder straps on one side and decorate the other.

Discussion

If any of the children have quilts at home, invite them to share them with the class or tell the history of their quilt.

Ecology Notebook

Go to the library and find out how wool is made from sheep and/or cotton is made from plants. Draw a diagram of one of the processes.

Write a recipe for a natural dye and try it out at home.

Puppet Show

Objective
To demonstrate the problem of solid waste and to encourage its reduction through recycling and limited use of disposable items.

Summary
Teachers and/or students perform a puppet show called **"Throw Away More and Enjoy It Less".**

Key Words
decompose natural resource pollution
recycle solid waste

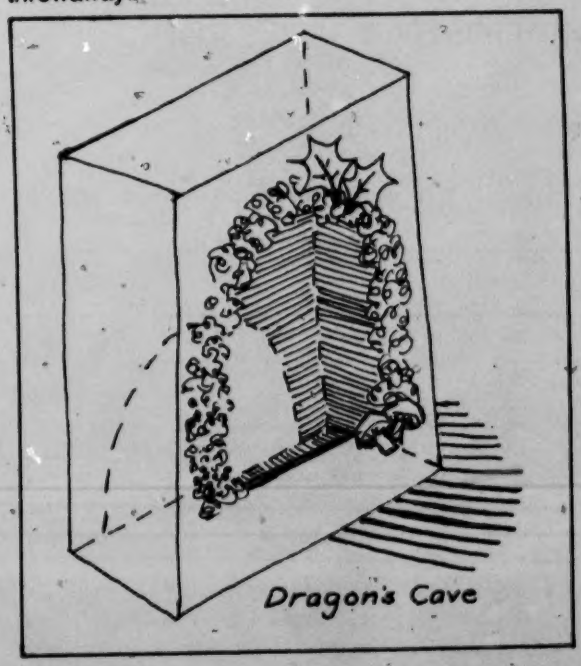
Advance Preparation
MATERIALS
Puppet Show (included)
3 puppets:
Dragon
Sneaky Sam the Salesman
Wizard
Improvise the characters with any puppets available, or make puppets as a class project.

Props for Dragon
small basket containing:
nuts, berries, mushrooms, pieces of bread
cloth napkin
small can for water
cave — see diagram

Props for Sneaky Sam
child's lunchbox containing:
small paper bags, baggies, paper napkins cut in quarters
small cans and bottles

Props for Wizard
tower — see diagram
portable recycling center — see diagram
squeeze bottle of talcum powder
green tablecloth (to cover stage area)

Teaching Suggestions
PROCEDURE
- Present the puppet show. Fill in the blanks with invented names and local settings.
- Help the Wizard lead the discussion on lunchtime throwaways.



• Suggest that two children from the audience take the parts of Sneaky Sam and the Dragon. Change the plots so that the Dragon already knows about recycling and outsmarts Sneaky Sam.

Wizard's Portable Recycling Center

Wizard's Tower

Throw Away More and Enjoy It Less

CHARACTERS
Dragon (Give the Dragon a name you like.)
Sneaky Sam the Salesman
Wizard (Give the Wizard a name you like, too.)

Stage Setting
This is a one-act play. The action takes place in a wooded area just outside the mouth of a large cave inhabited by a dragon. The cardboard cave is on one side of the stage or table which is covered with a green table cloth. The cave is painted brown and has twigs or moss glued around the opening. In front of the cave are scattered nuts, berries, and mushrooms.

Dragon:
Pops his head out of his cave. Note: While saying his part, the Dragon acts out collecting the nuts and mushrooms and eating.
Hi! I'm _____ the Dragon and I live in a cave in the forest at _____ Park. Have any of you kids ever seen me up there? Watch for me at mealtime, 'cause that's when I come out of my cave.
Dragon takes his picnic basket and tin bucket and puts them in front of his cave.
At lunch time I fill my basket with nuts and berries and lovely Dragon-fire-toasted mushrooms. And for dessert, I love to spread clover honey thick on my home-Dragon-baked bread. Mmm-mmm-MMM! To

top it all off, I like to take a bucket full of fresh mountain stream water and wash down the last crumb of my dee-lish-ous lunch!
I have a nice life, don't I? And the best part of the day is my afternoon nap in the sun.
Dragon lies down in front of his cave and starts to snore loudly.
ZZZZ ZZZZ

Sneaky Sam:
Comes up onto stage carrying his lunch pail full of goodies. He snoops around and discovers the dragon and starts to laugh.
Ha, Ha, Hee, Hee, Ho, Ho — Wait 'til I get through with this stupid dragon.
Looks up to audience.
He **is** a stupid dragon, isn't he?
He shakes the dragon.
Wake up you lazy dragon — wake up, before progress passes you by.

Dragon:
Turns over and looks up sleepily.
Do you realize that you're interrupting my daily mid-day snooze? Go away!

Sneaky Sam:
Wait a minute you silly dragon! You may be sorry if you pass up the offer I have for you. Besides, I'm a busy man and I don't have much time.
He looks up to the audience.
We modern people don't waste time taking naps, do we?

Dragon:
Awake and ready to listen to Sneaky Sam.
Before you tell me what you have to offer, why don't you tell me your name?

Sneaky Sam:
Why, of course, I'd like to introduce you to me *(he whispers)* Sneaky *(then says in a loud voice)* Sam the Salesman, and I'm here to sell you progress. Young dragon, why do you bother with that silly basket? Allow me to sell you a package of brown paper lunch bags.
He pulls some bags out of his lunch box.
They are so easy to fill *(he opens the bag)* and when you are finished with lunch you can simply throw them away.
He tosses the bag away.
And ... for your berries and honey bread, allow me to sell you some marvelous plastic bags.
Pulls out a plastic bag.
Aren't they splendid? They will keep your goodies fresh until you are ready to eat them — and then you can throw them away.
Tosses the plastic bag away.
And paper napkins are another development you cannot live without.
Sam wipes the dragon's mouth. The dragon playfully tries to eat it.
No, no, it's not for eating, just for wiping; then you just throw it away. But, best of all Dragon, I can sell you a drink in a bottle, or if you prefer, a can.
The dragon tries out the can and bottle.
Now you won't have to go to the stream and fetch water in that old bucket of yours ... And ... when you are done *(Dragon says it with him this time)* you can simply throw it away!

Dragon:
My goodness! How wonderful that all sounds. I'll take some of each.

Sneaky Sam:
Empties the lunchbox, dropping the bags, cans, etc., piece by piece into the dragon's cave.
Bye-bye, I'll be back next week with a fresh supply.

Dragon:
OK Sam, see you later.
Sam disappears.
Boy, I can't wait to try out all these new-fangled modern things. I think I'll eat an early supper.
He comes out of his cave, collects some nuts and berries and sits down to eat. He pulls out a juice can and starts to drink.
Oh, boy! These drinks **really** hit the spot and napkins really keep my face clean.
He throws the things in front of his cave. Then he goes into his cave.
I'd like to go to sleep, but there's nowhere to sleep with all these marvelous throw-aways in here.
He sticks some outside of the cave.
OK, now I can sleep — night, night.

Next morning.

Dragon:
Wakes up — stretches and yawns and brings out another bottle, bag, etc.
Oh! Good morning, folks. Time for a little breakfast.
He collects food, eats and throws stuff away. He looks around his cave.
Boy, this place is getting awful messy. Sneaky Sam didn't tell me this was going to happen. I'd like to get rid of some of this. Hey! I've got an idea.
He goes back into his cave.
I'm going to burn this stuff up.
He squirts a can of baby powder down low, so the audience only sees the smoke.
My goodness, that was no sollution at all. Now I have a lot of smoke and some awful gas from those plastic bags. They hardly burned at all.
He starts to cry and tries to push everything outside of his cave. The hole gets clogged up.

Sneaky Sam:
Appears
Here's Dragon's cave. I'll bet he's ready for more! Oh-oh, looks like trouble here!

Dragon:
In a weak voice from inside his cave.
Help, help!

Sneaky Sam:
Wow — I'm gettin' outa' here before there's trouble — Hee hee.
He runs away.

Dragon:
Keeps yelling weakly
Help, help!

Wizard:
Pops up where Sneaky Sam was, with the tower around him.
Hi, I'm _____ the Wizard and I live in a tower. I have very good eyes and especially good ears and right now I hear a cry of help from the hills — excuse me!
He ducks out of his tower and pops up by the dragon's cave.

I'm coming Dragon. Don't give up hope. Hey Dragon, you surely have yourself in a pile of trouble. Don't you know about recycling?

Dragon:
Pushes his way up through the garbage ... He gasps for air.
Help! What's recycle?

Wizard:
Ah, my friend, that's when you return things like bottles and cans to the manufacturer. He processes them and makes them over into new things. This way, the same materials can be used over and over. But those plastic bags — they can't be recycled and they don't decompose, either. And even worse, if you try to burn them they give off poisonous fumes.

Dragon:
Heavens, what's decompose?

Wizard:
It's a kind of recycling too. Some things, like paper and dead leaves and food scraps can go back into the earth. After awhile, they get *"processed"* and make better soil to grow things in. But not plastics. They stay just the way there are forever and ever. And they just pile up higher and higher like your garbage.

Dragon:
Wow! I never knew that!

Wizard:
And speaking of paper, Dragon, do you know where all those napkins and paper bags come from? They're made of trees.

Dragon:
Wow!

Wizard:
Can you imagine how many trees it must take every year to make so many paper bags and napkins?

Dragon:
My goodness!

He slips back into the pile.
Help!

Wizard:
Sorry, my friend. I got so busy lecturing, I forgot about your predicament. Let me see if I can get you some help from some of these young people. *Have Wizard pick a few specific children or you'll be mobbed!*
Take all that garbage he's buried under and put it in my recycle cans here. Be sure to watch the labels on the cans so you put the things in the right place. Thanks kids.
They sit down.
Well, Dragon, what do you have to say for yourself?

Dragon:
My goodness, friend Wizard, I had no idea I could get buried under all that garbage! I'm going to give up all that progress for my old lunch basket and water bucket. I guess sometimes you can get fooled by what you think is a good thing.

Wizard:
Yes, I guess you could even say that sometimes progress is just a lot of garbage.

Dragon:
Well, Wizard, thanks a lot for helping me out of my predicament.

Wizard:
I'll bet some of you kids have ideas about how you can cut down on your lunch time throwaways!

Discussion follows

More on Recycling

Math/Science
Collect the contents, except foodstuffs, of your waste basket for one week. Have the class determine a unit of measurement using a container from the classroom, (i.e. panfuls, drawerfuls). Measure the collected trash. Make a bar graph denoting the amount of paper used by the class in a week, a month, school year and then how much the whole school uses in a year.

Language Arts
Have students collect litter. Make an experience chart categorizing their finds using the following comparisons: big/small, rough/smooth, round/square, more than/less than, many/few.

Art
Children collect litter objects for an art project. Objects are painted and then used to make mobiles. Hang them in the classroom. Alternatively, the painted litter can be hung from a line stretching across the classroom.

Children find litter items for a collage. The items are attached to a board with nails or glue. The entire board is painted, then hung for display.

Group Activity
Have the class put all waste paper in a box. Do not crumple the paper. After one week, mark the level of the paper. The second week the class should use both sides of the paper. Determine whether less paper has been thrown away. Make a conscious effort to save the rest of the year.

Discussion
Discuss the pros and cons of progress.

Examples:	Good	Bad
paper napkins	easy to use	creates litter
plastic bottles	don't break	don't decompose
cars	fast, convenient	pollution
highways	fast transportation	pollution, unsightly

Ecology Notebook
Count the bottles and cans used in your household in one week. Figure how much you would use in one year.

Draw a map from your home to the nearest recycling center. Mark on your map the days and hours the center is open and take a copy home.

Darius

I am a newspaper that has already been read. I think it feels lousy, not wanted around, and boring "Good Grief."

Toys

Objective
To motivate the imaginative use of discarded materials.

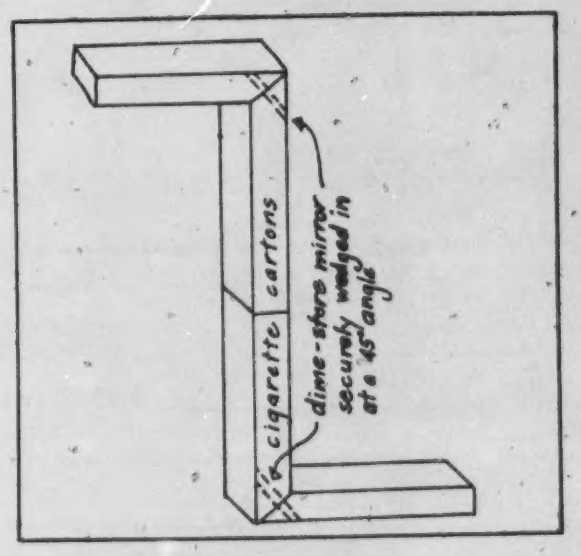
Summary
The teacher shows the class examples of toys she has made. She gives the children a choice of which toys they would like to make or, as an alternative, has the whole class make the same toy. This can be an ongoing activity until as many toys as desired are made.

Key Words
recycle

Advance Preparation
Make a few simple toys to stimulate the children's interest. Suggestions (can be made very quickly):
- clomper stompers
- juice-can telephones
- Alaskan yo-yo
- bleach ball toss
- newspaper cone yo-yo

List of materials and instructions follow.

Teaching Suggestions
Show students toy examples. This project can be approached by discussing any of the following topics: *recycling discards, reducing waste, saving money, lessening the pollution problem, conserving energy.* (Remember, it takes machines and fuel to make toys.) Making toys is one way in which each child can participate creatively and derive satisfaction.

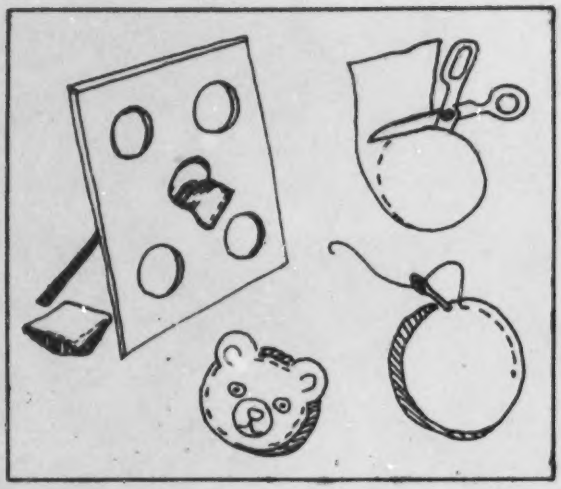


Toy Descriptions

PERISCOPE

Materials
4 cigarette cartons; 2 purse-size mirrors; masking tape

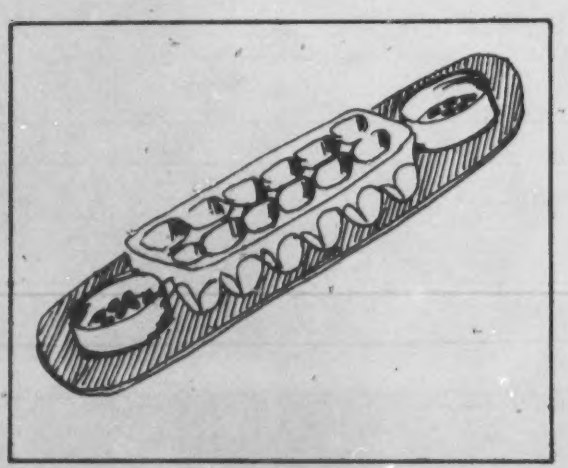
To Make
- Tape 4 cigarette cartons securely together.
- With cardboard and tape, wedge and tape 2 mirrors as shown.



BEAN BAGS

Materials
fabric scraps; dried beans; plastic "baggie"; scissors; needle, thread

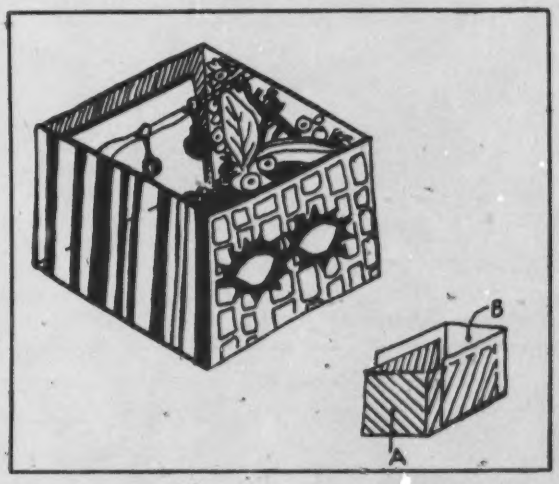
To Make
- Mark and cut 2 pieces of fabric to desired shape.
- With *right sides together*, sew along edges about ¾ of the way around bag.
- Turn bean bag right side out.
- Fill plastic "baggie" with beans and tie top.
- Fill bean bag with "baggie" and sew opening closed.



KALAH

Materials
stiff cardboard; egg carton; 2 tuna cans; dried beans, pebbles or marbles; glue

To Make
- Cut cardboard base as shown above.
- Mount egg carton and cans to board

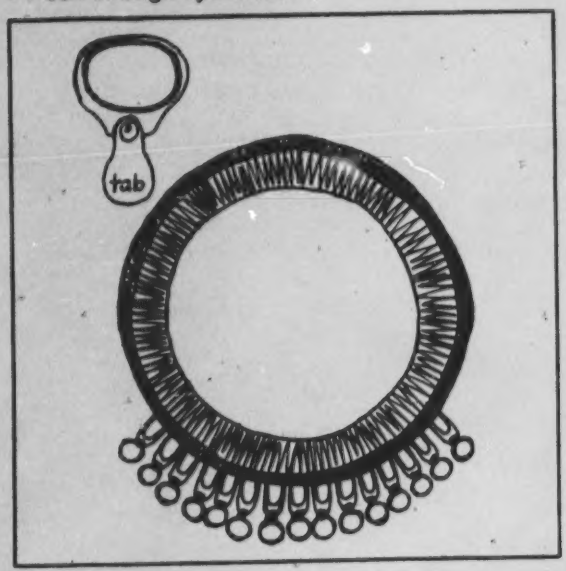


MAGIC BOX

Materials
shoebox; mirror; magazine pictures; Christmas ornaments; gift-wrap paper, tiny toys, junk jewelry, bells, rug scraps, cotton balls, seeds and nuts, tissue paper, ribbon, glittery things, glue; string, paint, tape, etc.
Note: Don't buy anything, use only discards.

To Make
- Cut shoe box in half.
- Glue or tape a mirror **securely** to the end of box part B.
- Cut eye holes into the end of part A.
- Tape or glue 2 parts together.
- Profusely decorate the inside of the box with as many of the above-mentioned materials as you can fit in.
- Paint or glue gift-wrap paper to outside of magic box.
- Cover top with tissue paper or strips of colored

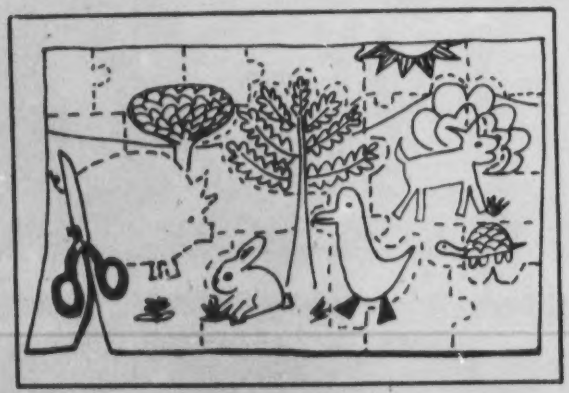
ribbon.
- Using string or ribbon, suspend bells and orgaments from above, as pictured.
- Peek through eye-holes!



TAMBOURINE

Materials
aluminum pie plate; paper clips; pop-tops; ice pick

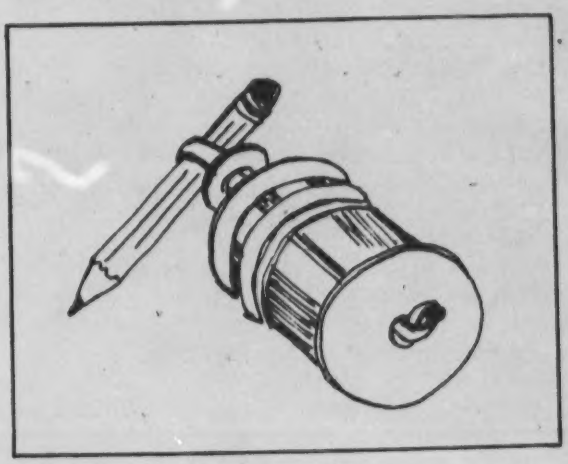
To Make
- Pull off tabs from pop-tops so only rings remain.
- Connect rings to paper clips.
- With an ice pick, punch holes into rim of pie plate.
- Connect paper clips to pie plate.



PUZZLE

Materials
light-weight cardboard; picture; glue; scissors

To Make
- Mount picture onto cardboard with glue.
- When it is dry, make puzzle cut-out lines on front or back of picture.
- Cut out puzzle along lines.

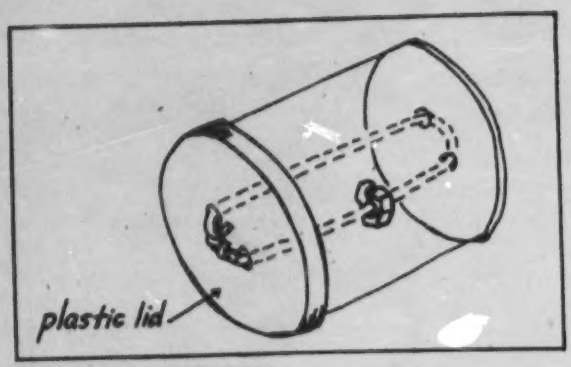


RACING SPOOL

Materials
large, empty thread spool; carpet tack; hammer; various sized rubber bands; rubber or metal washer; burned match stick or pencil stub

To Make
- Hammer a tack into one end of spool.
- Pass a sturdy rubber band, about the same length as the spool, through the spool and slip it around the tack.
- Attach washer and pencil stub to other end of rubber band as shown in picture.
- Wind up the rubber band until you have some tension on it. Then let it go.

Note: Racing spools are tricky to make. Try experimenting with different length rubber bands, different size washers; and rubber bands twisted around the middle of the spool for better traction. Try racing it on different floor surfaces.



MAGIC ROLLING CAN

Materials
tin can with plastic lid; rubber band; nut or other weight; ice pick

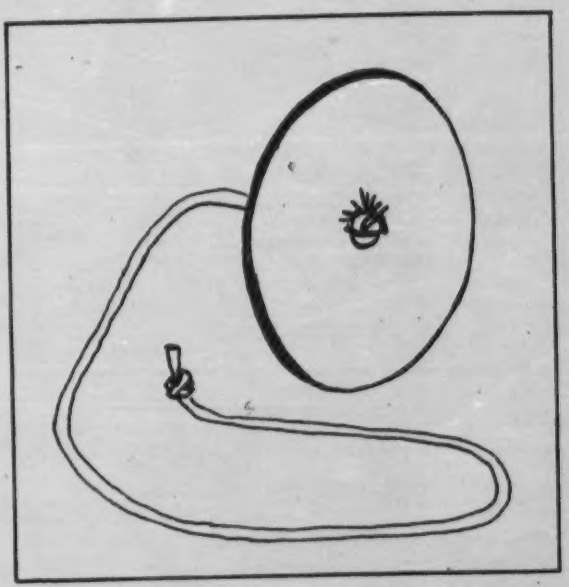
To Make
- Punch two holes in each end of can. (Holes should be evenly spaced from center.)
- Cut the rubber band and pass it through the four holes, looping it around the weight (nut) and tying the ends back together as pictured.
- Jiggle the can to make the weight wind around the rubber band to build tension.
- Roll it on a *smooth* surface. It should roll forward, then stop and roll back.

Note: This is a tricky toy and will need experimentation with rubber band and weight sizes, etc.

FINGER PUPPET

Materials
magazine pictures; cardboard; scissors; glue

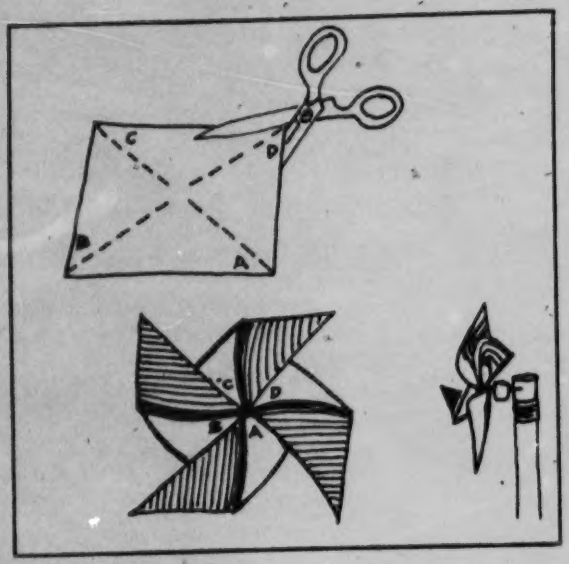
To Make
- Mount pictures to cardboard with glue.
- When dry, cut out puppet around figure. Leave a strip of cardboard at bottom about 1½" long.
- Fold over 1½" strip along line A.
- Punch finger holes in strip.



LEATHER MAGNET

Materials
medium-weight round leather scrap about 3" in diameter; hole punch; *strong* string about 12" long

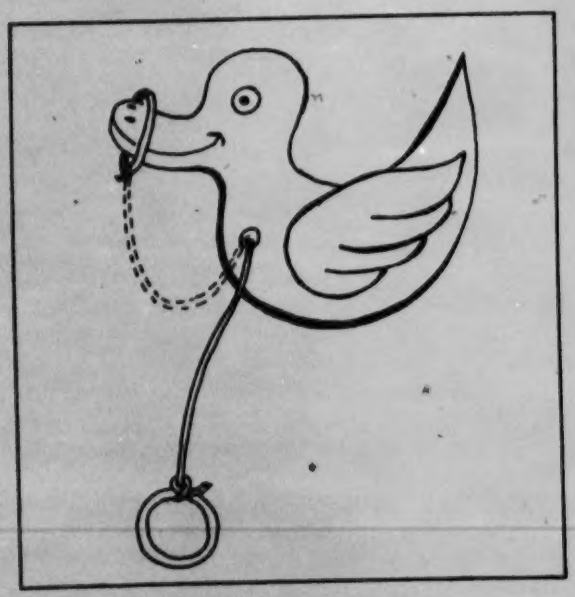
To Make
- Punch a hole in the center of the leather just large enough for string to pass through.
- Pass string through hole and tie a secure knot on each end of string.
- Thoroughly soak leather.
- Press it *firmly* against a *clean*, *smooth*-surfaced object. Lift.



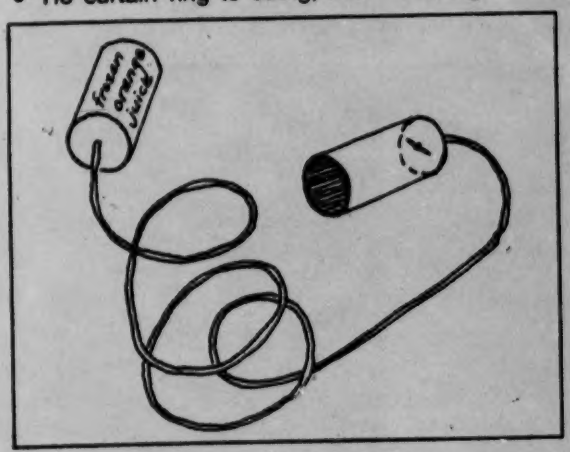
PINWHEEL

Materials
stiff paper; pin; bead; pencil with eraser

To Make
See instructions for making Pinwheel, **Energy** lesson, **Steam Generators** Activity Sheet.



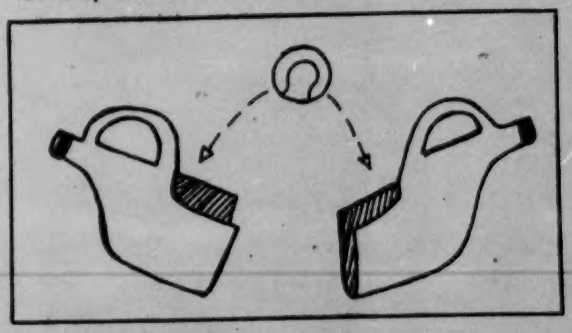
MEXICAN YO-YO
Materials
cardboard; string; curtain ring
To Make
- Cut cardboard into shape of a bird with long, up-curving beak.
- Punch hole in bird's breast.
- Tie curtain ring to string; then tie string to bird.



JUICE CAN TELEPHONES

Materials
2 cardboard, frozen juice cans, large or small; string, 12 or more feet long; 2 burned match sticks or toothpicks; ice pick

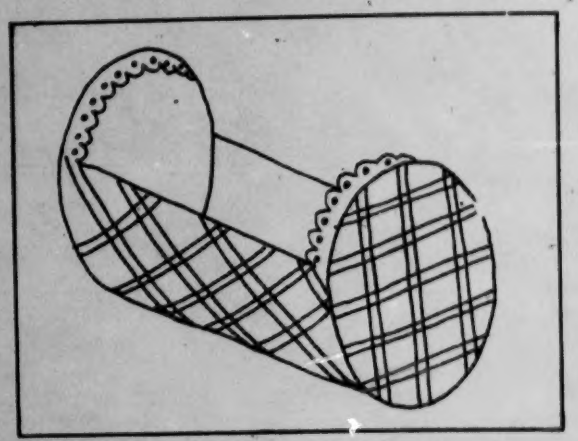
To Make
- Punch holes in centers of juice can bottoms.
- Pass ends of string through holes, securing knots with match sticks.
- String must be pulled straight and have tension on it for telephones to work.



BLEACH BOTTLE BALL TOSS

Materials
2 large empty plastic bleach bottles; scissors; old tennis ball or bean bag

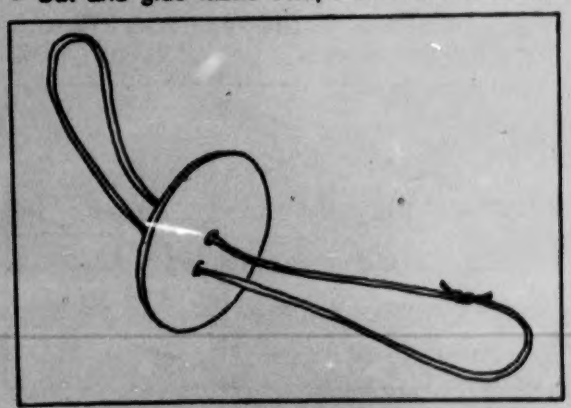
To Make
- Cut bottles to shape pictured above.
- Play "catch" with ball and bleach bottle scoops.



CRADLE

Materials
oat meal box and lid; fabric and trim scraps; glue; scissors

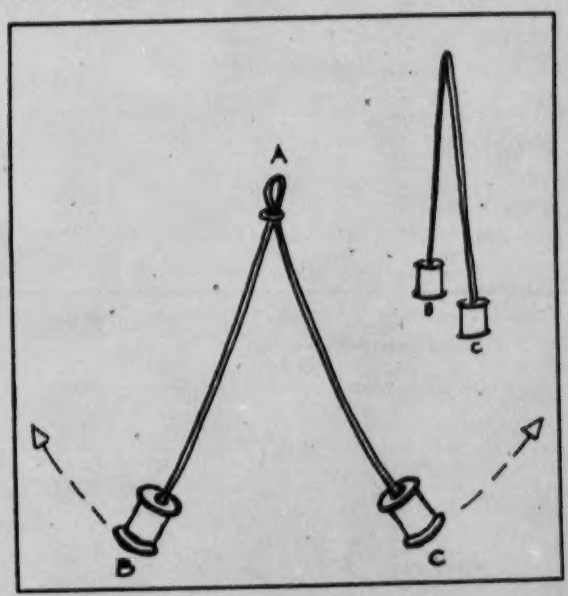
To Make
- Cut box to shape shown above.
- Cut and glue fabric scraps and trim to fit box.



WHIRLER

Materials
light-weight cotton string; button, 1" in diameter or larger with 2-4 holes, or cardboard circle or square 2" in diameter or larger

To Make
- Pass string, about 40" long, through button holes and knot.
- Holding each loop with thumb and index finger, twirl button in a circular motion until the string is wound around itself several times.
- Gently pull out on the loops; then give them slack as the button spins.



ALASKAN YO-YO

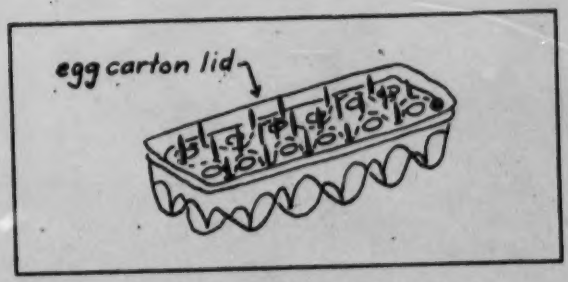
Materials
30" piece of string (approx.); 2 large, used thread spools.

To Make
- Tie one spool to each end of string.
- Double string allowing spool B to hang just above spool C
- Form a loop at point A with an overhand knot.
- Try spinning spools B and C in opposite directions.

JUMPING JACK

Materials
medium-weight cardboard; drawing paper; pencils and crayons; paper punch; brads; string; dowel or stick; glue

To Make
- Draw a picture of an animal, tin soldier, etc. Draw the body, the arms, and the legs separately, as pictured above.
- Mount the body pieces onto cardboard with glue and allow to dry. Cut out body parts with scissors.
- With a paper punch, make holes on the body, arms and legs where you want to connect the parts. Also, make a hole *at the top edge* of each arm and leg to attach string. (If holes are not at the top edge, the arms and legs will not "dance" when you pull the string.)
- Glue dowel to back side of body.
- Tie about 12" of string to each arm and leg.
- Attach arms and legs to body.
- Tie all four strings together at base of body. Knot end of string and pull.



EGG CARTON PIN-BALL

Materials
egg carton and lid; toothpicks; hole-punch; marble; scissors

To Make
- Cut lid off carton. Punch 12-14 marble size holes in lid, 6-7 in each row.
- Form path guidelines around holes with toothpicks.
- Set lid into egg carton bottom.
- Holding egg carton pin-ball, try to roll a marble along the path without the marble falling into the holes.

SOCK PUPPET

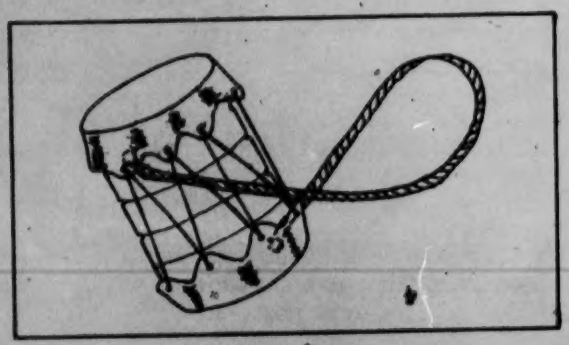
Materials
old sock; fabric scraps; buttons; needle and thread; scissors

To Make
- Cut mouth along dotted lines and fill in hole with contrasting fabric scrap as shown.
- Sew on ears, eyes, nose, etc.

NEWSPAPER CONE YO-YO

Materials
newspaper; thick yarn; rag-stuffed ball; stapler

To Make
- Make a ball. Stuff it with nylon stocking scraps, rags or foam.
- Before sewing up hole, insert yarn and knot it to the ball with a needle and thread.
- Connect the other end of the yarn to the base of the newspaper cone by turning point up and stapling (as shown).
- Try to flip the ball into the cone.



DRUM

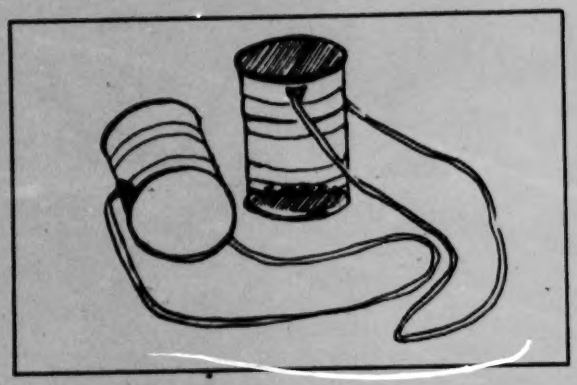
Materials
1-2 lb. coffee cans (without ends); rubber innertube scraps; string; shoulder-strap cord; scissors; hole punch; needle

To Make
- Punch holes in side of can. Pass shoulder-strap cord through holes and knot as shown.
- Place can on rubber scrap and mark a circle about 1½" wider than can top.
- Cut out 2 circles of this size.
- Punch holes in rubber about ½" from the edge and about 1½"-2" apart.
- Connect the rubber circles to the can by passing the string through the holes as shown in picture.

SPOOL KNITTING

Materials
large thread spool; finishing nails; medium weight yarn; crochet hook; hammer

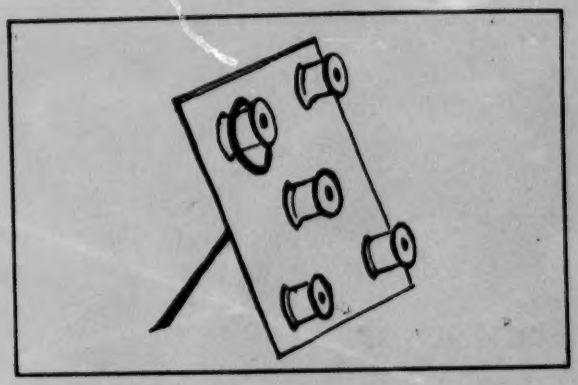
To Make
- Hammer 4 finishing nails into spool.
- Pass one end of yarn through spool hole and hold it in your left hand with the spool.
- Wind yarn around the nails two times in the pattern shown above.
- Using a crochet hook, catch loop A, pass it over loop B (leaving loop B on the nail), and over the nail head. Repeat this step all the way around and then rewind another pattern of yarn.
- Pull finished knitted yarn down through spool hole as you go.



CLOMPER STOMPERS

Materials
large, empty juice cans, with both ends intact. (Cans should have been punched open.) Two lengths strong cord, each about 50-55" long; can opener

To Make
- Make 2 holes, opposite each other, on sides of juice cans.
- Pass cord through holes and knot.
- Use clomper stompers like stilts.



RING TOSS

Materials
heavy cardboard; glue; large, used thread spools; large jar washers, curtain rings, empty tape spools, etc.

To Make
- Glue spools to cardboard.
- Brace cardboard as shown above or lean against a chair.
- Toss curtain rings or large jar washers over spools. Scoring points may be assigned to each spool, if desired.

More on Toys

Math/Science
Make toy instruments from discards (i.e. bottle band, sticks, drum, tamborine.) Form a rhythm band with others in your class.

Language Arts
Write a jump-rope rhyme.

Have children go to the library and find books on toys and games from foreign countries. Each child reads about and reports on one toy or game to the class. Example: **Folk Toys Around the World,** Joan Joseph, Parents' Magazine Press, New York, 1972.

Art
Invent a toy and draw a picture of it. Make a class gallery of invented toys.
Make a paperweight for an adult: Select an interesting smooth rock. Convert it to the thing it suggests by decorating it with paint (example: animal, car, etc.).

Group Activity
Have a class toy exchange. Bring toys you don't use and exchange them for others.

Have a class parachute contest. Name your parachute. Who won? Analyze the characteristics of the winning parachute.

Discussion
Ask your parents and grandparents what toys they made when they were young. Ask them to show you how to make them. Share your toy with the rest of the class.

What would you do if you only had a nickel to buy your mother a gift. (P.S. Don't be a cheapskate.)

Ecology Notebook
Make a list of all the games you play which require no bought equipment.

Draw a toy. Tell what natural resources were used to make it.

Energy

Objective
To demonstrate the concept of energy.

Summary
The children, divided into small groups, do five energy experiments: jet a balloon on a string, blast a baby bottle rocket, make a steam turbine pinwheel, shoot a cork, assemble wind and water mills. Alternative: Do each experiment with the entire class over a five day period.

Key Words
energy fuel machine power
solar energy

Advance Preparation
MATERIALS

Group I
The Jet Setters
string
balloon
straw
tape

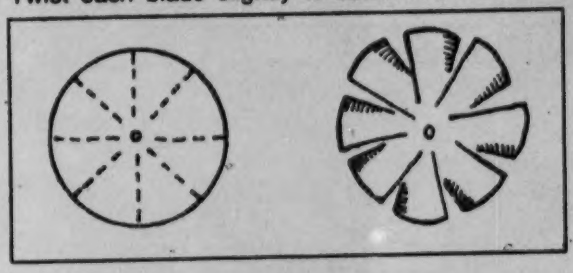
Group II
Rocket Blasters
vinegar
water
baking soda
plastic baby bottle
measuring spoons
dishpan
toilet paper

Group III
The Steam Generators
aluminum foil
scissors
pins
beads
whistling tea kettle
sauce pan
hot plate

Group IV
The Air Burners
glass bottle
cork
toothpick
rubber band
magnifying glass
3 matches

Group V
Wind and Water Wheeler Dealers
tin wheels (to be made in advance)
wire
toothpicks
thread
weights
glue (quick-drying variety)

To make tin wheels: Use tin can lids. Punch holes in center of lids. Cut into tin lids with tin snips along dotted lines, ending cuts about ¼" before hole. Twist each blade slightly to catch wind or water.



Teaching Suggestions
INTRODUCTION
What is energy? *The ability to do work.* What must we have to produce energy? *Fuel.* What kind of fuel produces human energy? *Food.* A car's energy? *Gasoline.* A rowboat? *Food.* A toaster? *Electricity.* What kind of fuel produces our electricity? *Coal, oil, water (find out what kind of fuel your local utility company uses).* What other ways is energy produced? *Sun, wind, water.*

Explain to the children that they are going to experiment with different kinds of energy by making little machines.

PROCEDURE

Outline activity for children. Each group will —

- select a recorder to take notes,
- read instructions before beginning,
- do activity,
- share its findings with the rest of the class.

Divide children into five groups. Pass out activity sheets and equipment.

Background Information

Energy is the ability to do work. Plants utilize the sun's energy for photosynthesis. Animals need energy for growth, warmth and hunting food. Man requires it in order to maintain life — work, run, jump, eat, etc., and machines need energy to function.

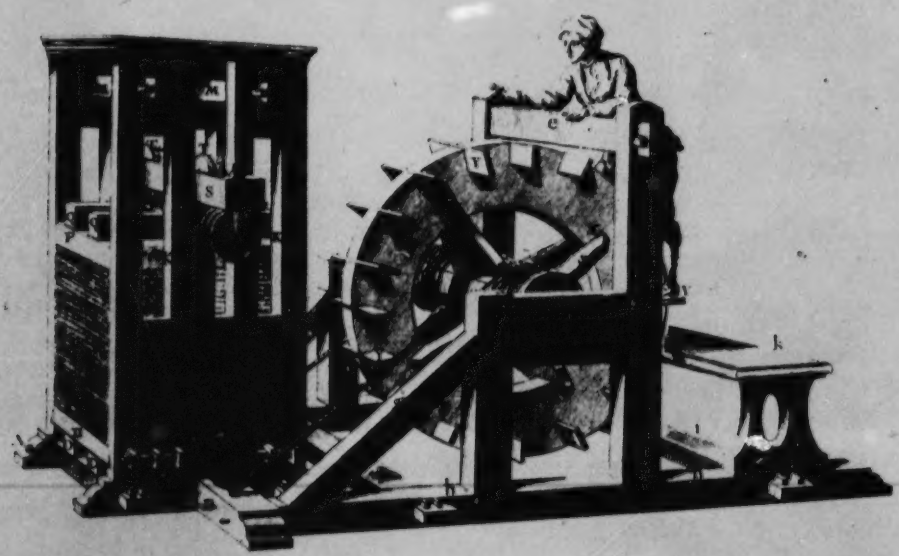
Animal energy is fueled by food. Man's work is often replaced by the use of machines. Many machines are run by electricity which is produced by burning oil, coal or natural gas. Over millions of years, dead plants and animals have been recycled by heat and pressure in the earth to form these fossil fuels. That is why these resources are limited and thus, nonrenewable.

Man uses fossil fuels in homes, industries, transportation and power plants. The fuels must be burned to produce energy and this combustion process givess off gases and particles which cause pollution.

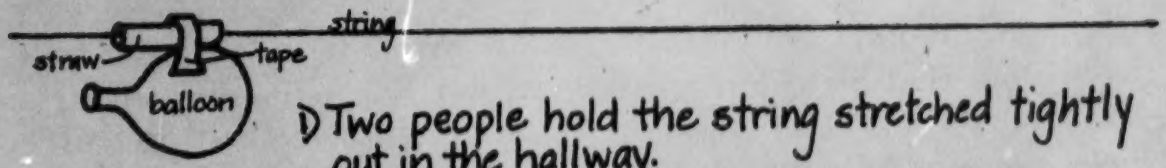
Other energy sources include solar, wind, water and nuclear energy. While nuclear energy does not produce the atmospheric pollution of fossil fuels, it does produce a highly radioactive by-product, *plutonium*, which retains its radioactivity for 500,000 years. Science has not yet developed a foolproof method of storage for this nuclear waste product.

Nuclear power plants require water for cooling. Discharging this heated water can disturb the ecological balance of aquatic communities by raising the temperature of rivers past the tolerance level for plant and animal life. This is called *thermal pollution*.

Work is now being done to develop the non-polluting and unlimited energy sources of wind, water and sun. If it were possible to harness 100 per cent of the energy radiated by the sun, in fifteen minutes we could capture enough energy to supply the power man needs for one year. Windmills are effective in harnessing wind energy, and solar heating systems have also been developed. Man must continue to seek economical ways of utilizing the unlimited energy sources before the limited sources of the earth are exhausted.



GROUP I: THE JET SETTERS



1) Two people hold the string stretched tightly out in the hallway.
2) Thread the straw onto the string.
3) Blow up the balloon.
4) Tape the balloon to the straw while you hold the neck of the balloon so no air escapes.
5) Let go of the balloon.

1) How far did the balloon go? _____
2) What made it go? _____
3) How could you have made it go farther? _____
4) What was its fuel? _____
5) Does a jet plane use the same fuel? _____
6) Why can't a jet plane run on the same fuel as the balloon? _____

_____

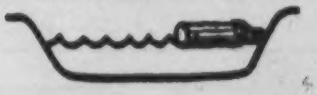
7) What kinds of pollution are caused by jet planes? _____

_____

GROUP II: ROCKET BLASTERS

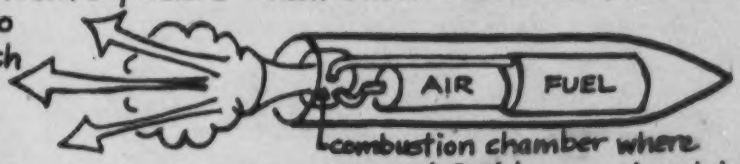
1) Fill a dishpan with water. The water should be at least 3 inches deep.
2) Put 1 teaspoon of baking soda into a square of toilet paper and twist it closed.

3) Pour ½ cup water into a plastic baby bottle. Add ¼ cup vinegar to the water.
4) Drop the tissue with the baking soda into the plastic baby bottle.
5) Quickly screw the nipple onto the bottle and give it two shakes.
6) Quickly put the baby bottle into the dishpan full of water and stand back!



1) About how far did your rocket go? _____
2) What might have made it go farther? _____
3) What might have held it back? _____

A rocket gets its energy from explosions which shoot the rocket forward. Air and fuel are needed to cause the explosions which fire the rocket.

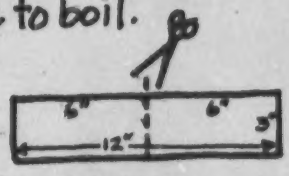


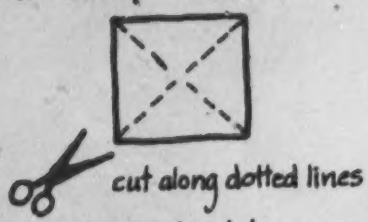
combustion chamber where air and fuel burn and explode.

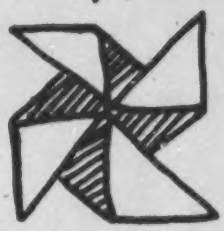
4) What made your rocket go? _____
5) What kind of fuel did it use? _____
6) Did your rocket cause pollution? _____
7) What kind of pollution does a big rocket cause? _____

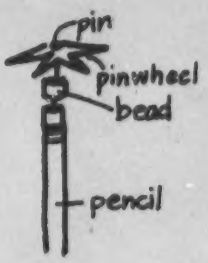
GROUP III: THE STEAM GENERATORS

1) Put about 2 cups of water in the tea kettle and half-fill your pan. Put the tea kettle and the pan on the hot plate to boil.
2) Turn on the hot plate.
3) Tear a strip of aluminum foil 3 inches wide
4) Cut the aluminum strip in half.
5) Fold your strip in half to make a square 3 inches by 3 inches.
6) Make a pinwheel.









7) Pin the pinwheel to a pencil as shown in the picture.

*

1) First hold your pinwheel over the boiling water in the pan? Be careful not to burn your hand. Does it spin? _____

2) Now hold it up to the tea kettle steam. Does it spin? _____

3) Why does one kind of steam make it spin and the other doesn't? _____

_____

Many engines are run by steam turbines. Instead of using a kettle, they use boilers.

4) What kind of fuel did you use to heat your boiler? _____

5) Where does electricity come from? _____

6) What kind of fuel does a steam locomotive use? _____
a steamship? _____

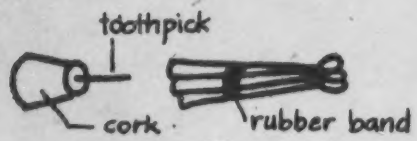
7) What kinds of pollution do they cause? _____

_____

GROUP IV: THE AIR BURNERS

Follow the pictures to complete your experiment.

1)



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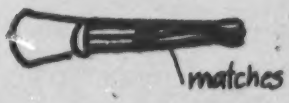

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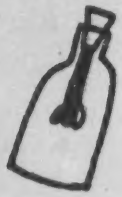


Don't push cork in too tight.

4)

1) What happened? _____

2) What was in the bottle besides the matches, cork and stick? (Clue: You cannot see it; it's invisible) _____

3) What happens to air when it gets hot? _____

4) What made the cork pop out of the bottle? _____

_____

5) Many engines run on explosions caused by fire burning gases. What was the gas in your bottle? _____

GROUP V: WIND AND WATER WHEELER DEALERS

Glue your tin wheel to a piece of wire 10 inches long. Make sure it is straight, not leaning. Handle the wheel carefully. It is sharp.

Holding the wire gently between your two index fingers, blow on your wheel. Now take it to the water and hold it under the faucet. Turn the water on to a gentle flow — then on hard.

1) Which made your wheel go best? _____

2) Which made your wheel go least? _____

3) What is the difference? _____

_____

Now tie a small weight to a short string. Wrap it a few times around the wire. Can you make your wheel pick up the weight?

yes _____ no _____

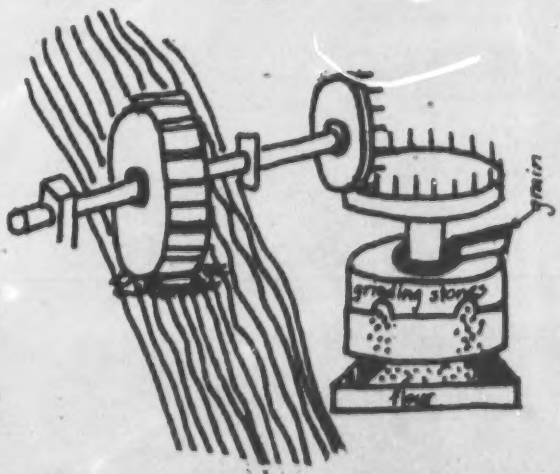
Water wheels and wind mills were once used to grind flour. Today they make electricity.

4) Can you think of any problems in using wind and water power today? _____

_____

_____

5) Do wind or water mills cause pollution? _____



More on Energy

Math/Science

To illustrate solar energy, place a bowl of water in a sunny window. Students test the water before and after to note the difference in temperature. (This may be done with hands or thermometer.)

Language Arts

Make a class-study of how man kept time before electricity was discovered. Illustrate each timepiece and write instructions for its use under the picture. Make an eye-catching book cover for your report. Share it with other classes.

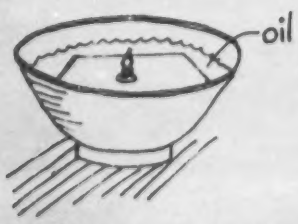
Art

Have a poster campaign to encourage use of public transportation. Hang the posters in local shopping centers.

Group Activities

Conduct the class without benefit of plastics, glass, wood or metals for one hour. Have children decide what activities they can do.

Cover a small piece of particle board with tin foil. Make a hole just big enough for a candle wick to fit through. Insert 2" of wick, leaving ¼" on top and the rest underneath. Float it in a bowl of salad oil and light it (see diagram).



Discussion

Do we need to conserve air, water and sun? How have humans changed the earth? *Good-Bad.* Do you think people should have to pay for natural resources? Do you think we will ever have to pay for the sun we use?

Ecology Notebook

Make a list of 13 things you personally use around your house which use electricity (anything with plugs) or gas.

- Draw a line through 3 things you could easily live without.
- Draw circles around the 3 things you would give up last.

Imagine you were an American Indian living many years ago. What kind of energy did you use to:

- Travel
- Heat your home
- Light your home
- Wash your clothes
- Make your tools
- Keep food
- Entertain yourself

What kind of energy do you use today to:

- Travel
- Heat your home
- Light your home
- Wash your clothes
- Make your tools
- Keep food
- Entertain yourself

Pollution

Objective
To examine air and water pollution and its causes.

Summary
The children, divided into small groups, do four pollution experiments: funnel polluted water, test air pollution on a card and a cloth, test the rate of decomposition of various materials and examine how plants absorb pollution.

Key Words
energy fossil fuel pollution smog thermal pollution

Advance Preparation
MATERIALS

clean white sock (for class demonstration)
4 activity sheets, one per group (included)

Group I
The Funnelers
2 funnels
cotton balls
sand
filter paper or paper towels
3 glass jars
jar, full of polluted water (water mixed with dirt, tobacco, oil, food coloring, ashes, dry leaves, etc.)
¼ cup bleach

Group II
Pollutant Collectors
white (3x5) cards
vaseline
clean white cloth
plastic bag
masking tape

Group III
Paper Shakers
5 or more jars with lids
5 or more types of paper (ie. toilet paper, newspaper, paper bag, aluminum foil, wax paper, writing paper, cellophane, etc.)

Group IV
Celery Stalkers
1 stalk celery
1 jar
red food color
water

Gather each group's materials and set up at stations around the classroom.

Teaching Suggestions
INTRODUCTION

How many different types of pollution can you name? *Air pollution/smog, water pollution, litter, noise, thermal pollution, radioactive waste.* What causes these types of pollution? *Burning fuels, dumping wastes in rivers, trash, cars/jets/factories/construction, power plant wastes, plutonium.* How can pollution be cut down? *Smog controls, more responsible use of energy, regulation of industries, etc.* How can we (students) help control pollution? *Ride bikes, walk, don't litter, turn off appliances when not in use.*

PROCEDURE

To test auto pollution — Take the class outside. Cover a car exhaust pipe with a clean sock. Let the car idle for 5 — 10 minutes. Warning: Make sure children stand away from car fumes. What can we tell by looking at the sock? Is all pollution visible?

Outline activity for children. Each group will —
- read instructions before beginning experiment
- perform experiment
- explain experiment to the rest of the class.

Divide the children into four groups.
Pass out experiment sheets and equipment.

Background Information

Air and water are resources vital to the health of all living things, yet both our waterways and skies are treated as though huge quantities of chemicals can be added to them without any serious consequences to the biotic systems.

Even where no human — generated pollution exists, it is impossible to find absolutely *pure* water because water is a solvent which absorbs naturally occuring minerals and wastes. However, water can be purified by natural processes including bleaching by the sun, settling, oxidation, dilution and consumption of pollutants by bacteria. In addition, a chemical purification process occurs when oxygen in the water combines with organic wastes. These natural processes, however, cannot keep up with the current rate of water contamination in some areas. When bacteria from wastes are able to out-compete water plants and animals for the oxygen supply, rivers, lakes and oceans become "sick" and the ecological balance is altered.

There are numerous sources of water pollution but the three most significant are: municipalities, agriculture and industry. Contaminants such as detergent and DDT are carried to the water system through the drains of homes and businesses. However, agriculture and large industry are much larger consumers of water and consequently are responsible for about two-thirds of all water pollution.

Widespread use of chemical fertilizers and pesticides creates an enormous amount of pollution because plants are unable to absorb all the chemicals sprayed on or fed to them. The excess ends up in all the water by runoff or by absroption into the ground water. When nitrogen from fertilizers gets into the water it encourages the growth of algae and other water plants. As these plants grow they clog or choke rivers and streams. Some chemicals from pesticides found in drinking water may be poisonous to both man and animals.

Factories pour waste such as greases, chlorides, mercury, and paper pulp into the water. Many waste treatment plants are antiquated and therefore cannot effectively remove these wastes. Even when water looks and tastes pure, it may contain DDT or radioactive material.

Harmful bacteria in wastes have turned shellfish into disease carriers. Once contamination enters the food chain, especially at the lower levels, the consequences can be severe. Some industrial chemicals and wastes such as chromium, beryllium, petroleum and radioactive wastes are carcenogenic.

Another serious pollution problem occurs when industry uses large amounts of water for cooling. When hot water is dumped into rivers, it can raise the water temperature 10 — 20 degrees, which adversely affects natural purification systems and upsets cycles of aquatic life.

Like water, the air contains a certain amount of natural pollution caused by dust, pollen and naturally occuring gases, but pollution does not become a problem until the air becomes heavily concentrated with smoke and gases. The most common sources of air pollution are: auto exhaust, furnaces and incinerators, oil refineries, steel mills and other heavy industry. We all have experienced the unpleasant effects of smog such as eye irritation and poor visibility, but no one is sure just what the long range effects of exposure to smog are. Air pollution is most harmful to the sick, the very old and the very young. Various poisons such as sulfer dioxide, carbon monoxide and oxides of nitrogen resulting mainly from burning fuels cause headaches, stomach aches, pneumonia, emphysema and other chronic diseases. In addition to the human disease, air pollution causes damage to plants and animals, fading and deterioration of fabrics and rubber, and loss of crops.

But the most frightening aspect of air pollution is a phenomenon called *synergism*, resulting when two already poisonous chemicals combine in the

atmosphere to produce effects which are far more serious than either of the two single parts.

Attempts to solve pollution have yielded some satisfactory results. Government control of industry, for example, has been effective in some instances. Lakes classified as dead systems have come "alive" when citizen action and governmental control combined to halt industrial abuse. Nevertheless, much remains to be done, and citizen awareness is the first step in combating the problems of pollution.

GROUP I: THE FUNNELERS

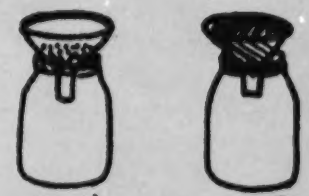
1) Put some cotton in the bottom of one funnel.

2) Add sand until the funnel is ½ full.

3) Put a filter paper in the other funnel.

4) Put each funnel over an empty jar.

5) Pour some polluted water through each funnel.



6) Compare the water. Which is cleanest? _____

7) Add a few drops of bleach to either container of water. What happens? _____

8) Do we really get rid of the pollution? _____

_____

9) How does it smell? _____

The experiment you just did shows one way that factories and cities clean dirty water.

GROUP II: POLLUTANT COLLECTORS

1) Draw squares on your cards.

2) Spread a thin layer of vaseline inside each square.

3) Put the pollutant collectors in different places around the classroom.

4) Put one pollutant collector on the window or window ledge outside the classroom.

5) Check the samples after 2 days, after 1 week, after 2 weeks.

6) Compare the samples.

———*———

1) Cut a piece of clean white cloth into 2 pieces.

2) Put one piece in a plastic bag and keep it in a clean place in your classroom.

3) Tape the other piece on the outside of a window.

4) Compare the two pieces of cloth after 2 days, after 1 week, after 2 weeks.

5) What happened? _____

GROUP III: PAPER SHAKERS

1) Fill each container 3/4 full of water.

2) In each container put a different type of paper.

3) Put the lids on and shake.

4) Shake three times a day.

5) What happens to the paper? Which dissolves first, second, etc.?

Type of paper	Day it dissolves

This experiment shows what happens to paper that we dump into toilets, rivers and the ocean.

GROUP IV: CELERY STALKERS

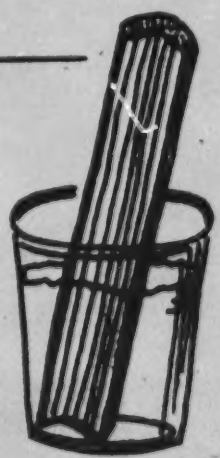
1) Fill a container 3/4 full of water.

2) Add 3 drops of food dye.

3) Put a stalk of celery into the water.

4) Check often to see what happens.

5) What does this tell you about how pollutants get from the water to plants?



This experiment shows how chemicals from the soil and water get into plants.

More on Pollution

Math/Science

Make a class chart with the following headings: Kind of car, Number of miles/gal. and Cost of 100 mile trip in your car.

Figure out three 100 mile trips you could take on a bus and find out how much each one would cost. Compare them to the cost of car trips.

Language Arts

Have the children do a puppet show or pantomime based on Dr. Seuss' *The Lorax*.

Art

Have children collect magazine pictures depicting environmental problems and mount them on construction paper. Invent a headline for each picture and make a book to keep them in the classroom.

Make up a game "Pin the Trash on Porky Polluter".

Group Activity

Play "What Am I?":
Pin the name of a pollutant on a student's back. (Example: plastic bag, pop top, candy wrapper.) The student must guess what he is by asking questions such as: "What color am I?, Will I decompose?", etc.

Discussion

To test noise pollution, take the class outside. Have them sit still for several minutes, then discuss the diferent sounds they heard and their reactions to various noises.

Debate: Man, the most dangerous animal.

Ecology Notebook

Draw a picture of a natural scene. Draw another picture of the same scene after man has been there.

Record the smog level for one week. (Hint: What color is the sky?) Suggested ratings: clear, light smog, heavy smog. How does weather affect smog? Write your answer. Compare your results with other students.

Food Web

Objective
To illustrate the concepts of food web, community and interdependence.

Summary

Each child is given a card naming an animal and what it eats. He connects his animal with all the plants and animals it eats on the food web board. He also draws a picture of his animal and its food sources in a forest setting.

Key Words
community ecology food web
interdependence preying insects

Advance Preparation
MATERIALS
A Food Web Board made with the following materials:
black paint
1 piece particle board, 24"x24"x¾"
38 finishing nails, 1¼" long
38 labels, 3"x½"

Instructions for constructing Food Web Board:
- Paint particle board black.
- Outline a circle on the board, 18½" diameter.
- Mark 38 evenly spaced x's in pencil (approx. 1½" apart) on circle to mark nail placement.
- Hammer nails securely into board.
- Copy labels from Appendix Sheet, Forest Plants and Animals.
- Cut out labels and adhere to board in alphabetical order, one label next to each nail.

4-8 spools of brightly colored (polyester) thread in contrasting colors.
1 chopstick
1 animal card per child (see master list, Appendix Sheet, Forest Animals)
Drawing paper
Crayons

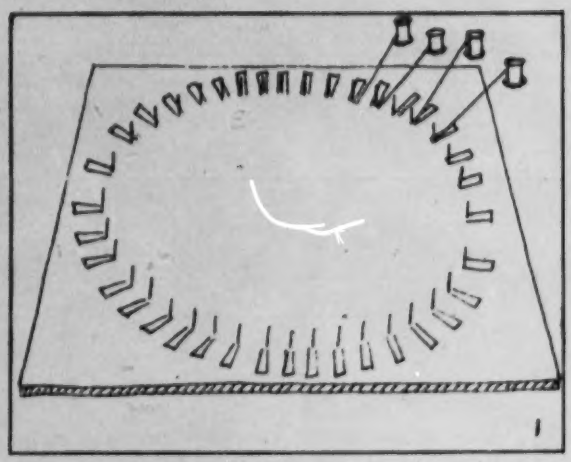
Teaching Suggestions
INTRODUCTION
The children will see this project first as an art activity, but they will begin to make connections and ask questions on their own as they see what is developing on the board.

Explain to the children that they are going to make a Food Web Board. Have a brief discussion about the meaning of the word web.

PROCEDURE
At their desks:
- pass out animal cards and drawing paper
- have children draw a picture of the their animal and everything it eats in a forest setting while some take turns at the food web board.

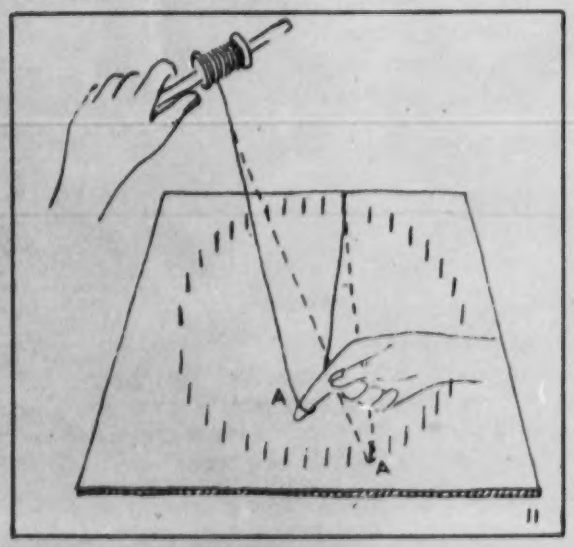
At the Food Web Board:
Teacher connects thread from spools to first 4-8 animals (not plants) on board. (see diagram I.)

Work at the Board must be supervised by the teacher or an aide.



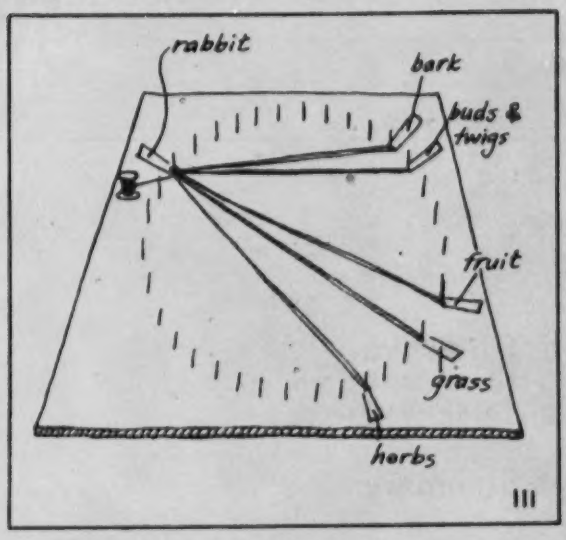
I

• call children to board, 4—5 at a time, in alphabetical order (by animal's names).
• Slip chopstick through first spool hole. When you pull the string off the spool it should roll easily. (see diagram II).
• One child holds chopstick while another pulls thread around the nail of first animal or plant it eats, then back around starting point and on to next food source, until his animal is connected to each of its food sources. (see diagram II)



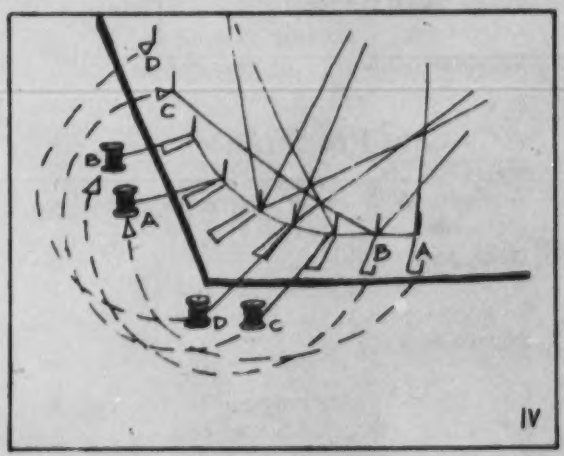
II

When child is finished...
• Teacher pulls up thread to get tension on web, then winds thread around starting animal's nail several times (see diagram III).



III

• Remove chopstick from first spool and slip it through the second.
• Second child proceeds in same manner as first.
• When all spools have been used, pull thread from spool one around the **outside** of the circle and twist it around the first free animal nail. Reset all spools in same manner (see diagram IV).

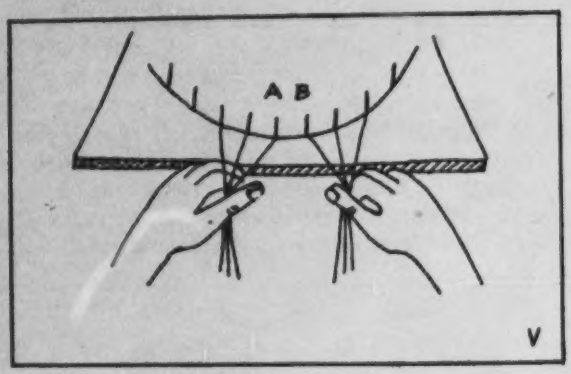


IV

• With next child in line repeat steps above until all animals on board have been connected to their food sources.
• Before tying off board, make sure that all threads have tension on them.

52

• Leaving a tail of about 8—10" from each nail, cut threads.
• Holding half the threads in one hand and half in the other, tie a square knot around a central nail. (see diagram V, nail A or B.)



V

Background Information

Plants and animals live in communities in which their needs for food and shelter can be met. Each species lives in the community to which it is best adapted. The forest community is one. Some others are the desert, ocean, grass-lands and mountains. Within these communities or habitats one animal may serve as food for another, but a balance usually exists because each animal occupies its own niche or role within the community. For example, one bird will make its nest and find its food on the forest floor while another nests and eats only in the top branches of the trees. In the forest, animal niches are found in layers: forest floor, herb layer, shrub layer, understory and canopy.

Although each animal occupies a specific niche, interdependence among living things exists within two structures: the food chain and the food pyramid. The former constitutes a hierarchy of food sources, while the latter involves energy or trophic levels. Within any community, plants always form the initial link of a food chain. Although not every animal eats plants, the owl that eats a shrew that ate a caterpillar that ate a leaf, depends upon plants just as much as any plant-eating animal does. The links which connect the larger animals to their food sources and so on down the line to the final link, plants (in the form of leaves, buds, twigs, herbs, grass, etc.) comprise a food chain.

A food pyramid is a much more complex concept because it deals not only with the number of each species a community can support, but also with the transfer of enrgy (needed for growth, warmth and daily activities). Any community of living organisms could not exist without non-living components; water, air, soil, and sun, a basic energy source for all life. Photosynthesis is the process by which plants convert the sun's energy into food for growth. Green plants are the only form of life which make their own food. Therefore they are often called "food machines" or producers, while animals are called consumers, because they cannot manufacture their own food. In a food pyramid, this energy moves from the plant (producer) up through the pyramid of primary consumer (herbivore) to secondary consumer (carnivore) to the top of the pyramid, secondary carnivore (or predator) which makes use of only 0.1% of the energy originally captured by the plants at the bottom. For this reason, the animal at the top of the pyramid, must consume a great deal more than those at the lower level to sustain his life processes. This is why a given square mile of land might support 18,000 mice and nearly 23,000 other herbivores, such as rabbits, birds, and insects, while it can support only two hawks, two owls, and a coyote. At the lower levels of the food chain, animals are specialists, that is, they may feed on only one kind of leaf, grass or herb; but at higher levels of the pyramid, animals become less specialized.

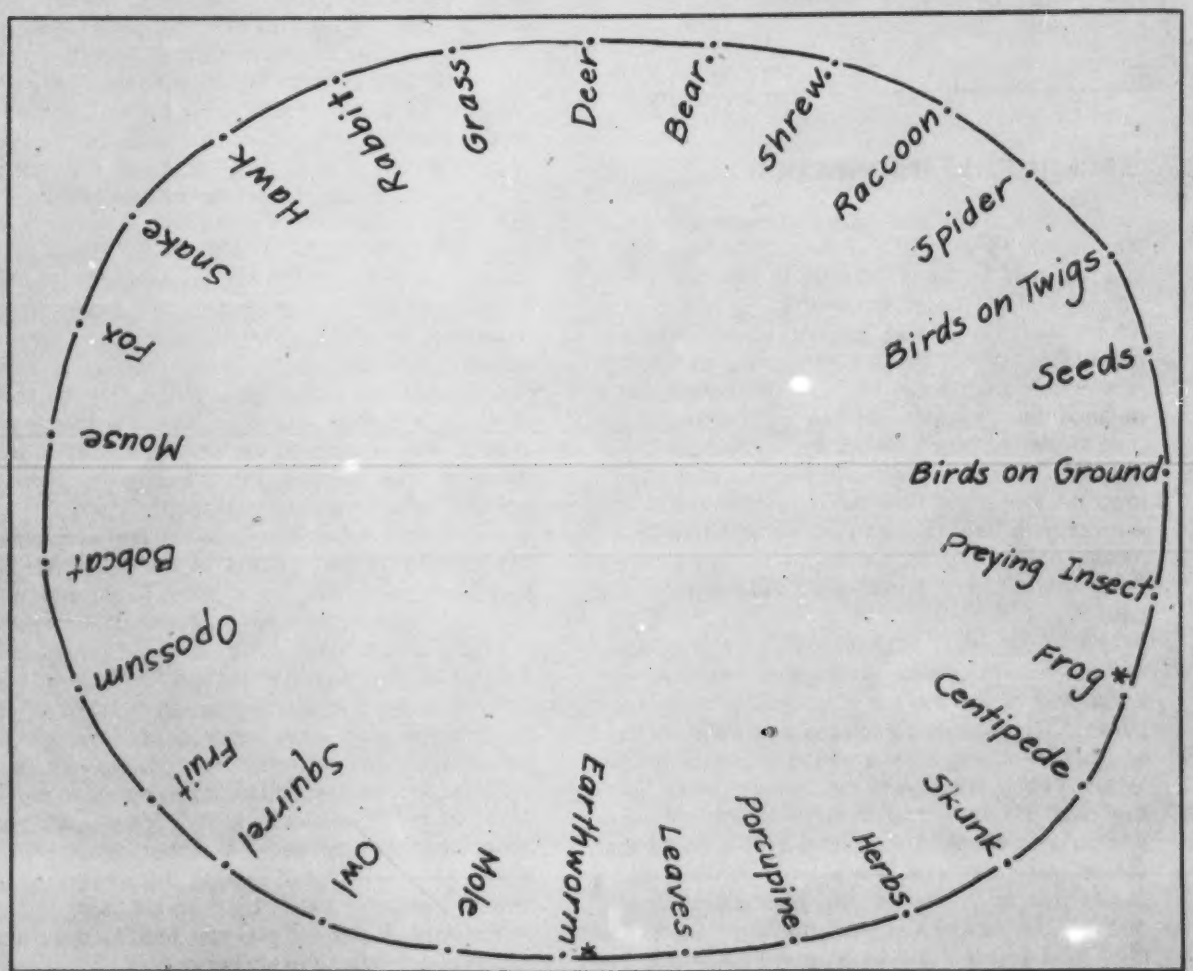
The continuing existence of any community depends upon the process of death and decay. Eventually, everything living in the forest returns to the soil. Decomposition is a complex process involving an intricate set of steps. Only a small number of soil creatures can feed on freshly fallen or killed plant and animal matter. Most other soil animals and fungi enter the process of decomposition at other stages, after the material has been softened and further broken down by micro-organisms. In the forest community, scavengers feed upon dead carcasses while other decomposers feed upon dead plants, leaving the remains to be further broken down by various fungi. This decomposition process provides food for the plants and thus continues the life cycle.

Alternate Food Web
for younger children

Each student is given a card with the name and/or picture of a plant or animal. Also on the cards are the names of two other animals that it eats or that eat it. Students look for what they eat or hide from what eats them. At the end, each student catches prey by taking its hand so that a continuous circle of interdependence is created. Children should then go around the circle saying what they are, what ate them and/or what they ate.

Copy and cut out the twenty-eight animal/plant cards from Appendix sheet, Alternate Food Web.

Important: The original model includes twenty-eight participants. For a group of twenty-three eliminate **centipede, porcupine, leaves, herbs** and **skunk** and substitute the * (asterisk) cards for the original **frog** and **earthworm** cards. You must use all cards or the circle will be incomplete.



More on The Food Web

Math/Science

Read about an insect and a large animal.
Answer the following questions about your animals:

- How long does each one live?
- How often does each one have babies?
- How many babies does each one have?
- Who or what are each ones enemies?
- Can you draw some conclusions about your findings.

Language Arts

Pick an animal or plant from the Board. Write a story or poem about its life in the forest.

Environmental Bingo Game

Teacher:

- Pass out grid sheets to students.
- At blackboard, hold up the pictures one at a time. Have students agree on a word that describes the picture. (Example: Bobcat — predetor, Rabbit — herbivore, Mushroom — fungus.)
- Have students pick different squares on their grids and fill in the word.
- Repeat steps b & c until all squares on the grid have been filled in with words.
- Using buttons or seeds, play the game. (The teacher shuffles the cards. She holds them up one at a time. Students cover their corresponding words until one player gets four in a row in any direction.

Note: For younger children, the words name the picture.

Art

Make a class collage of cut-out pictures from magazines featuring forest plants and animals.

Group Activity

Have Food Web Relay Race

- Make a set of cards with names or pictures of plants and animals from the Food Web Board.
- Divide the class into two teams.
- Set up a goal on a table across the room from the starting line.
- Set 5 cards, face up, on the table.
- Name an animal in the Food Web.
- On "go" the first member of each team runs to the goal and picks a card naming a food that the named animal eats and runs to the end of his team's line.
- Place 5 more cards down and repeat process.

Make a bulletin board using the Food Web Board and the children's drawings.

Discussion

Where would you put the sun, air, soil and water on your Food Web?

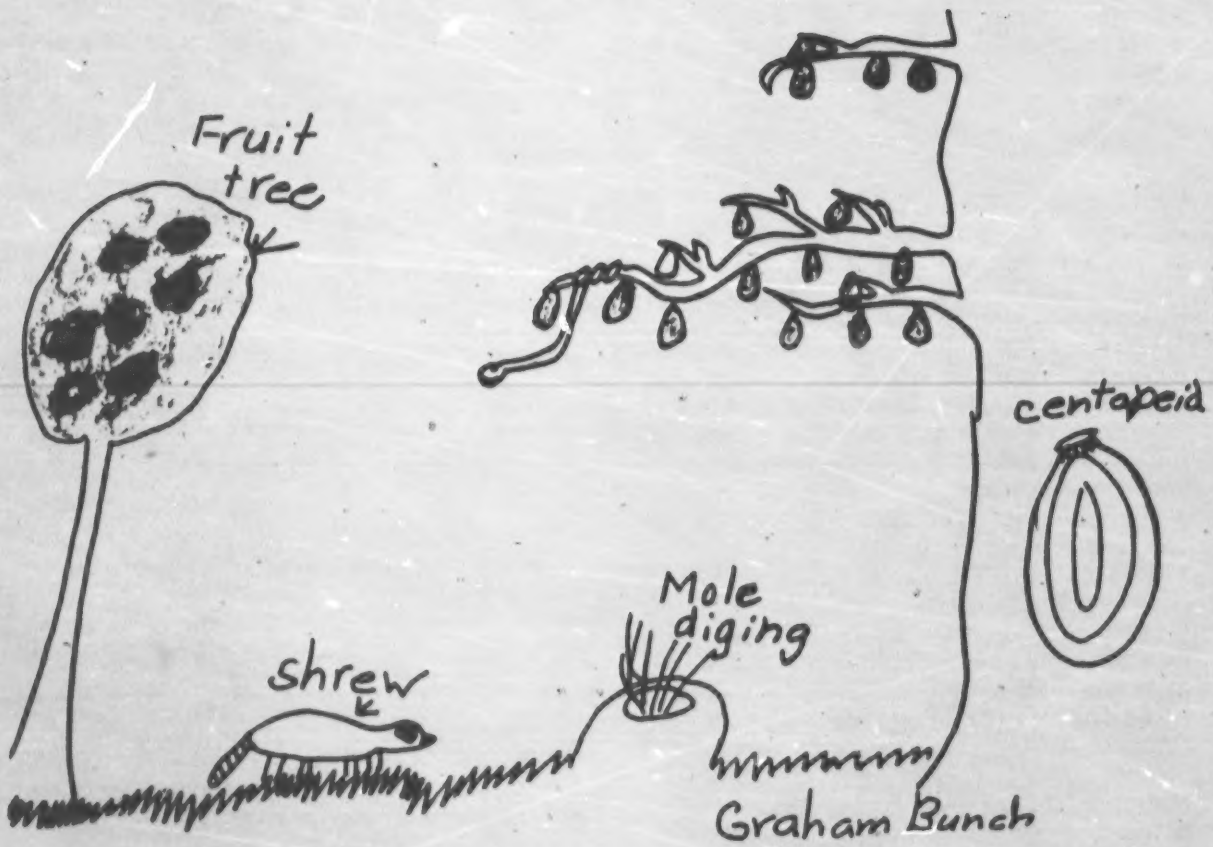
- Which animals would they be connectd to?
- Pick one of these four things and tell why or how animals and plants depend on it.

Ecology Notebook

What other habitats or communities are there beside the forest? List as many as you can.

Read **It's Time Now**. Write a report or draw pictures comparing your life during the four seasons with life in the book. Find out what changes take place in a forest during the four seasons.

Pick an animals on the Food Web Board. Find out which animals eat it. Find out which animals it eats. Draw a diagram of your findings.



I am a snake and I am just about to jump on a shrew.

The Forest Community

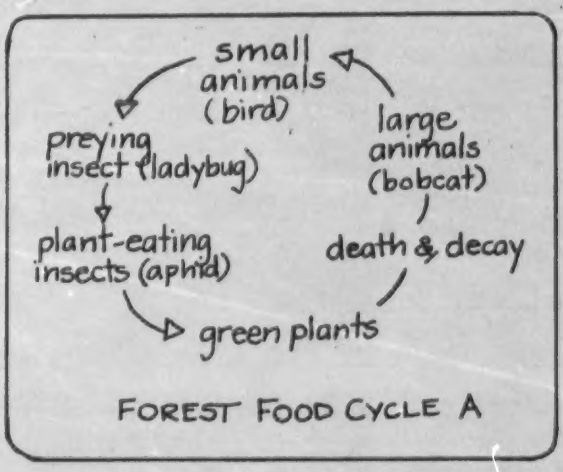
Objective
To introduce the concept of *Food cycles* and to reinforce the concept of *interdependence.*

Summary
Teacher and children together create a butcher paper or blackboard mural of a forest community including all animals that can be expected to share the habitat. This leads to an illustrated discussion of food cycles and the interdependence of life forms.

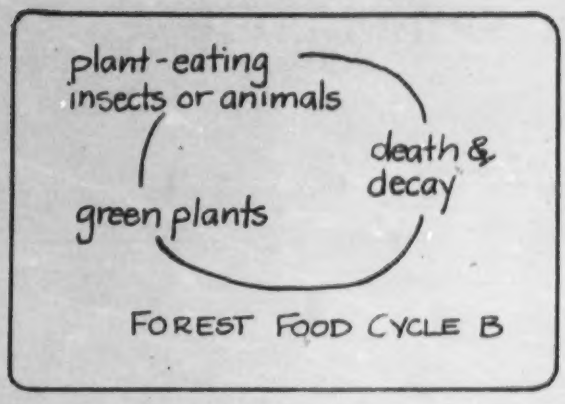
Key Words
carnivore community cycle decay decomposers food cycle habitat herbivore interdependence omnivore scavenger

Advance Preparation
MATERIALS
blackboard/butcher paper
colored chalk/crayons
Food Web Board (optional)

Teaching Suggestions
PROCEDURE
- Children draw a mural beginning with plants and filling in with animals. The mural will be finished when it contains a generous sampling of forest plants and animals.
- Children sit in front of the mural, while the teacher leads a discussion.
- **Possible questions for discussion:** Could we make a food web right on this picture? How could we do it? *By connecting all the animals to what they eat.* Why do we call this a forest community? *Groups of plants and animals living together in the same environment.* What is interdependence? *Depending on each other.*
- **Forest Food Cycle discussion** (illustrate it on the blackboard using the cycles pictured below). Why do animals need plants in the forest? *For food and shelter.* Who eats the plants? *Plant-eating insects and animals — herbivores.* Who eats the plant-eating animals? *Preying insects and meat-eating animals — carnivores.* Do plants eat large animals? *No.* Where do plants get food? *From the soil.* Then what is missing from our cycle? What do we need in the empty space to make food for the plants? *Death and decay.*



FOREST FOOD CYCLE A



How do dead plants and animals decay? *Beetles, flies, fungi, worms, etc.* What if there were no decay? *Dead plants and animals would pile up.* How do we connect decay with green plants? *Decomposers break down dead plants and animals to provide food for the soil.*

More on The Forest Community

Math/Science

Make a Mobius strip of one of nature's cycles (*i.e.* water cycle, life cycle of a plant/animal, the seasons, etc.).

- Cut a long strip of paper and divide it into sections for your cycle pictures.
- Draw pictures on it to tell the story of the cycle you choose.
- Twist the strip and tape ends to form a ring. Now answer these questions about your strip.
- How many sides does it have?
- How many squares are there?
- Where does it start and stop?
- Does what's happening in the square start and stop?
- What does this tell you about cycles?

(If you don't know how to make a Mobius strip ask a math teacher.)

Language Arts

Write a Haiku poem about life in the forest.

Art

Make a 3-D relief in clay of a forest community. Find out if you can put it in the office for a week.

Start a class collection of animal and plant pictures from old magazines. Make collages of other communities.

Group Activity

Cut animal pictures out of magazines. Paste them on the appropriate class chart titled *herbivore, carnivore* or *omnivore.*

Discussion

What other habitats or communities are there besides the forest? Name as many as you can. Are there any animals in the forest that could live in other habitats? Are there any animals that can live in only one habitat?

Read *Annie and the Old One.* Have a class discussion on death as part of the life cycle.

Ecology Notebook

Draw animals in a habitat where they don't normally live. Example: fish in a tree.

Food Chains

Objective
To demonstrate that plants are the basic food source for all animals.

Summary
Assuming the role of either plant, insect, mouse, or bobcat, each child participates in a mock predator — prey sequence to discover the food pyramid's ultimate dependence upon plant life.

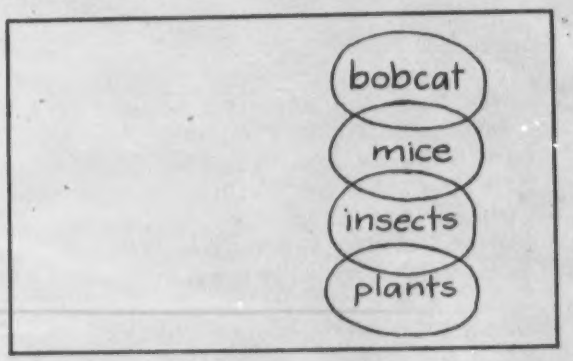
Key Words
consumer food chain food pyramid
predator prey producer survival

Advance Preparation
MATERIALS
paper bag
20 slips green paper representing plants
4 slips yellow paper representing insects
2 slips orange paper representing mice
1 slip blue paper representing a bobcat
27 total — **Note:** Match the total number of slips to the number of students by adding or subtracting plants.

Teaching Suggestions
INTRODUCTION
- Review the Forest Food Cycle (from the Forest Community Mural lesson).
- Explain to the children that they are going to play a game.

PROCEDURE
- Pass around paper bag containing slips of colored paper and have each child draw from it.
- Explain color coding (see advance preparation).
- Plants form into four clusters in a cleared space.
- Insects stand up. Each insect eats one cluster of plants. (Plants crouch down and pretend to be in the insects' stomachs.)
- Mice stand up. Each mouse eats two insects. (Insects crouch down. Point out that both plants and insects are now in the mice's stomachs.)
- Bobcat leaps from his chair and captures the mice. (Now everyone is inside the bobcat's stomach and he is the only one left standing.)
- Questions for discussion (use blackboard to illustrate):

— Who ate the plants? insects? mice?
— Who ate the bobcat?
— How might he die? *Old age, disease, accident, starvation.*



— This is called a food chain: plants — insects — mice — bobcat.
— What is the most important part of a food chain? *Plants — because all animals ultimately depend*

on plants. Illustrate this by having the bobcat fall dead. Examine what happens to the other links in the chain. Next have the plants wither and die. Examine the results again.

— Does the bobcat eat plants? Does he need them? Why? How about the mice? *All animals indirectly eat plants.*

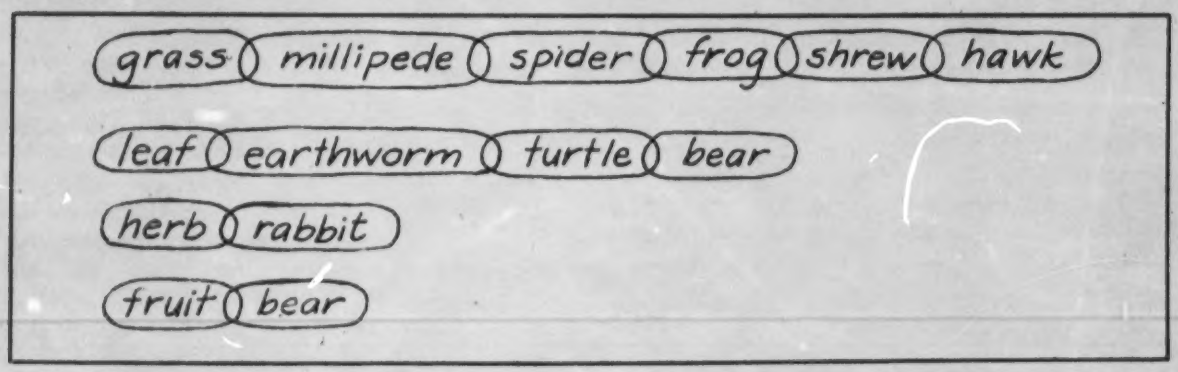
— What do plants eat? *They are food machines; they make their own food from sun, soil and water.*

— What is the bottom link in any food chain no matter which animal we begin with? *A plant.*

— What would you answer if someone asked you, "Have you thanked a green plant today?" Why?

• To make a food chain: start with any animal. Link it to anything it eats. Keep making links until you reach a green plant.

Examples: *grass — millipedes — spider — frog — shrew — hawk*
herbs — rabbit
leaves — earthworm — turtle — bear
fruit — bear



More on Food Chains

Math/Science

Try the following experiment: If you have a class animal such as a rabbit or a hamster, weigh the animal at the beginning of the day and again at day's end. Also weigh its food before it eats. Did it gain weight after eating? Do the experiment for a week and plot the findings on a chart. Draw conclusions from your findings. *What other purposes does eating serve besides weight gain.*

To study predator — prey relationships, make a terrarium containing:

PREDATOR	**PREY** (plant-eaters)
chameleon/lizard	beetles
toad	grasshoppers/crickets
ladybug	aphids

Keep a record of what happens.

Date_____
Name of Predator_____
Name of Prey_____

	After 3 days	After 1 wk.	After 2 wks.
Number of Predators			
Number of Prey			

Language Arts

Read *The Day They Parachuted Cats on Borneo* to the class. Assign a group of students to dramatize it for the rest of the class or another class.

Art

Pick an animal on the food web board and trace the food chain back to plants. Then make a large paper chain and label each link with the appropriate food.

Group Activity

Make a card game like **Fish.** On one side of each card put a picture of an animal or plant. (Make sure you plan your chains before you make your cards.) Follow the same rules as fish, but you have a **book** in this game when you have a food chain. (The chain may have two or more links in it.)

Discussion

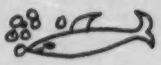
Eliminate one link of the forest food chain. Determine the effects this has on all other inhabitants of the forest. Pick another link. Are the results different? *If bobcats are eliminated would any animals be left with no food? Would there be an over population of some animals because there is no predator? Etc.*

What does this sentence mean? A growing child should drink three tall grasses of milk a day. *Hint for teacher:* To produce one cup of milk, a cow must eat five pounds of plants, five quarts of water and a pinch of salt.

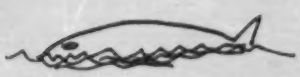
Ecology Notebook

Fill in the chart below with the names of three pet animals and three wild animals which you do not find in a forest.

	ANIMAL	HERBIVORE	CARNIVORE	OMNIVORE
1				
2				
3				
4				
5				
6				



Fish
Swiming, hunting
hunted, fearing, hateing.
Whale
Shwallowing Fish



Marya Lieberman

School Yard Eco-systems

Objective
To recognize that communities of interdependent living things exist in all environments.

Summary
Working in five groups, the children perform investigations outside, then return to the classroom to share their findings. The five groups are: Seed Scouts, Hula-Hoop Hurlers, Decay Detectives, Animal Hunters, Bug Eyes.

Key Words
decay decompose ecosystem
environment lichen mildew
mold niche

Advance Preparation
MATERIALS
5 activity sheets, one per group (included)

Group I
Seed Scouts
trowel
soil container

Group II
Bug Eyes
trowel
jar
sample container

Group III
Decay Detectives
sample container

Group IV
Animal Hunters
sample container

Group V
Hula-Hoop Hurlers
hula-hoop or string to mark off 3' x 3' area
trowel
sample container

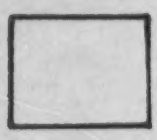
Teaching Suggestions
INTRODUCTION
Do you think a community of living things exists in the schoolyard environment?
Do you think we can find food chains here?

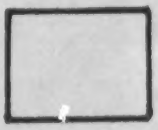
PROCEDURE
Outline activity for children. Each group will –
- select a recorder to take notes
- read its activity sheet before going outside
- go outside and perform its investigation
- share its findings with the rest of the class on its return.

Divide children into five groups.
Pass out activity sheets and equipment.

GROUP 1: SEED SCOUTS

1- Find 3 seeds. When you go back to the classroom, take your seeds and tape or glue them in the boxes below.





_____ _____ _____

2- If you know the name of the plant that your seed came from, write it on the line under the box.

3- Guess how the seed got where you found it. (Hint: by a bird, an animal, a person, through the air)

seed 1 seed 2 seed 3

_____ _____ _____

4- Would it grow where you found it?

Seed 1: yes___ no___ reason_____

Seed 2: yes___ no___ reason_____

Seed 3: yes___ no___ reason_____

5- Put some good soil that has no plants in it in your container. Take it back to the classroom and keep it watered. Put it in a sunny spot. Watch what happens.

GROUP II: BUG EYES

1- Find two bugs. Answer all the questions below about your bugs.

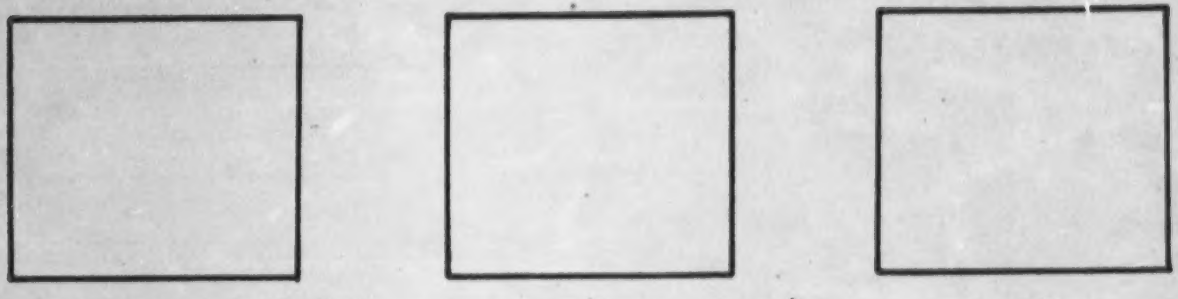
	BUG 1	BUG 2
a- It feels like:		
b- How does it move?		
c- Where is its home?		
d- How does it protect itself?		
e- What does it eat?		
f- Will it change into something else?		
g- How might it die?		
h- What will happen if it dies and stays there?		
i- Can you find its:		
eyes		
nose		
mouth		
feet		

2- Make a food chain for one of the bugs. (Clue: What does it eat? What eats it?) Draw it on the back of the paper.

3- Bring a soil sample back to the classroom. On a white piece of paper, sift through the soil for bugs. Put bug eggs you find in a jar and see if they hatch.

GROUP III: DECAY DETECTIVES

1- Look for signs of decay. (rot) Check shady, moist areas and see if you can find mushrooms, molds, diseased plants, mildew, rotting wood, moss or lichen. If you can, take three samples of decay back to the classroom with you and tape or glue the samples in the boxes.



2- Answer the following questions about your samples:

a- What color is it?

Decay 1 _____
Decay 2 _____
Decay 3 _____

b- Where did you find it?

Decay 1 _____
Decay 2 _____
Decay 3 _____

c- Is it wet or dry?

Decay 1 _____
Decay 2 _____
Decay 3 _____

3- Turn over a rock and look for decaying things. What else did you find under the rock?

GROUP IV: ANIMAL HUNTERS

1- Find signs of animals larger than insects. List the animals' names and the evidence you found to prove they were there.

	Animal's Name	Evidence
1		
2		
3		

2- Find 2 animal homes. Answer the questions below.

	Animal 1	Animal 2
a- Where is the animal home?		
b- What animal lives there?		
c- Is the animal at home.		
d- Are there other animals nearby?		
e- Is it safe from other animals?		

3- Make a food chain for one of the animals you found. (Clue: What does it eat? What eats it?) Draw the food chain on the back side of the paper.

4- Bring back a small animal in your container to show the rest of the class.

GROUP V: HULA HOOP HURLERS

1- Toss a hula hoop over an area covered with soil. Record all the living, non-living and once-living things you find inside the hoop.

Living	Non-living	Once-living

2- Dig into the soil and see what you find. Record what you found in the space below.

3- If you found something that is decomposing (rotting) name it and guess how long it's been there.

4- If you found something that will not decompose, name it and guess how long it's been there.

5- Bring back samples of what you found.

GROUP III: MOLD MANAGERS

1) Put about one inch of sand in your terrarium.
2) Moisten the sand with water but do not make it too wet.
3) Put the different items on top of the sand. (Examples: rubber band, wood, leather, plastic, cotton ball, nylon cloth)
4) Cover the top.
5) Check every few days to make sure the sand is wet. Pour a little more water in as it is needed.
6) After you have made your mold garden, have a contest. Each person in the group should write down one item he thinks will mold and one item that won't mold.
7) Write down your guesses. See who wins the contest.
8) Record the items as they mold.

Name of Item	Date Item Molded

Library Exploring: What is mold?

GROUP IV: LANDFILLERS

1) Put a layer of soil in a jar. Wet the soil.

2) Put pieces of garbage against the side of the jar so you can see them.

3) Put a layer of soil on top of the garbage.

4) Press more garbage against the glass.

5) Keep doing this until your jar is almost full. End with a layer of soil.

6) Cover jar.

Library Exploring
What is a land fill? Where do the materials that once filled the spaces go? Explain what could happen to a house that is built on a landfill.

More on School Yard Eco-systems

Math/Science

Play "Who am I". Pick an animal in the schoolyard. Do not tell its name. Describe its actions and home. The child who guesses correctly takes the next turn.

Draw a map of the schoo' environment. Show where plants and animals live, show where children play. Does play disturb the plants or animals?

Language Arts

Have each child think up one *how, what, why or when* question that has occurred to him during this unit and write it down. Put all the questions in a box. Start the day or afternoon each day by having someone pick a question and try to answer it.

Art

Habitat Graffiti Murals

Put four blank pieces of poster board up. Label them *Vacant Lot, City Street, Beach* and *Park*. Keep crayons or magic markers out so students can add to them as they think of living, non-living and once living things that belong to each habitat. After a period of time, compare these habitats with each other and with the non-human habitats you have previously studied.

Group Activity

How might you attract more wildlife to your schoolyard area? Do something about it. *Hint: Make bird-feeders* (see toy unit).

Play a game: **Everything is Interconnected.** Sit in a circle with a big ball. Let one person begin by naming an animal/plant or other natural phenomenon. He rolls the ball across the circle and the person who receives the ball must say, *"x is connected to y."* He rolls the ball on and the next person connects y to z, and so on, until someone gets stuck.

Discussion

Do plants and animals in a schoolyard ecosystem depend on people for their survival? Explain your answer.

Ecology Notebook

Look quickly (so as not to disturb) under the same rock every day at the same time. Record what you see and at the end of the week write a story called **"Life Under a Rock".**

Mold
natures killer
rotting, destroying, killing
mean, green, dirty, thing
Mold

John Hanson

Decomposition

Objective
To demonstrate decomposition and its relationship to the rest of the life cycle.

Summary
The children, divided into six groups, make the following: spore prints, a mold garden using biodegradable materials only, a mold garden using both biodegradable and non-biodegradable materials, a landfill, an earthworm farm and a bread mold experiment. Alternative: Do each experiment with the entire class over a five day period.

Key Words
biodegradable decay decompose earthworm fungi landfill mold spore synthetic

Advance Preparation
MATERIALS
6 activity sheets, one per group (included)

Group I — Spore Explorers
mushrooms (supermarket variety with exposed gills).
covers for mushrooms (plastic or paper cups)
white paper

Group II — Mold Makers
sand
terrarium or improvised container (glass mixing bowl at least 3" deep)
kitchen scraps (see activity sheet)
cover (plastic wrap) for terrarium

Group III — Mold Managers
sand
terrarium or improvised container (glass mixing bowl at least 3" deep)
non-biodegradable items (see activity sheet)
biodegradable items (see activity sheet)
cover for terrarium

Group IV — Landfillers
wide-mouth glass jar
kitchen scraps
soil
cover

Group V — Worm Watchers
terrarium or very large glass jar
soil
earthworms (from the garden)
kitchen scraps and cereal (earthworm food)

Group VI — Bready Bunch
bread
cellophane bags

Gather each group's materials and set up at stations around the classroom.

Teaching Suggestions
INTRODUCTION
Review decomposition's important role in the life cycle (See *Forest Community — food cycle discussion).*
Explain to the children that today's activities will give them a chance to observe the process of decay and decomposition.

PROCEDURE

Outline activity for children. Each group will —

- select a recorder
- read its activity sheet before beginning
- set up its experiment
- explain to the rest of the class the purpose of their experiment.

Divide children into six groups.

Distribute sheets and send groups to activity stations.

Background Information

Decomposition is an involved process. Microorganisms such as bacteria and fungi begin the process. Unlike green plants, these microorganisms do not make their own food, but receive nourishment from other plants and animals. In decomposition microorganisms break down dead plant and animal material releasing nutrients that can be used by green plants. Thus they function as a connection between dead plants and animals and living plants within the life cycle.

Yeasts, molds, mushrooms and other types of fungi are involved in decomposition. The seeds of fungi are called spores. Spores are microscopic, but can be seen as a group with the naked eye. The mass of spores cause the different colors which may be seen on molds. In a mushroom they grow inside the gills and drop when mature. Millions may be shot out, but only a few find the necessary conditions to grow and reproduce. Tiny fungal threads called mycelium grow from germinating spores. Some types of fungi grow underground and send up mushrooms when it is time to reproduce. Other fungi grow more on the surface of their host and do not form mushrooms.

The bacteria involved in decomposition live mostly in the soil. Bacteria are one-celled and divide in two by a process called fission. These bacteria may be very different from the ones used in making cheese or the ones that cause disease.

Other organisms follow the bacteria and fungi in the process of decomposition. Next to arrive are nematodes which feast off the bacteria. Eventually, earthworms and other decomposers break down what is left into humus. Earthworms do this by passing poor soil and organic matter through their bodies and discharging it in the form of castings (enriched soil).

A landfill is a method of disposing of garbage by burying and covering it with a layer of soil. Aeration needed to decompose materials is lacking so decay takes place slowly. Some material, such as paper, has been found intact some 25 years after being buried. Other materials, however, decompose more rapidly, forming holes and causing the surface to settle. This makes construction dangerous.

GROUP I: SPORE EXPLORERS

1) On a table, place a sheet of paper.

2) Cut or twist the stem of your mushroom close to the top.

3) Place your mushroom cap on the sheet of paper.

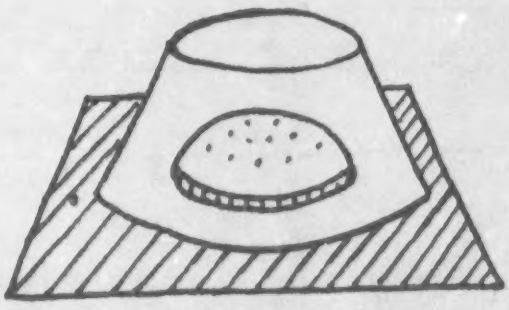
4) Put the cover over the mushroom. Leave it in a safe place where it will not be disturbed.

5) Tomorrow morning, carefully pick up the dish and mushroom cap. You will see a spore print. Show it to your classmates before you move it.

Library Exploring

What is the purpose of mushroom spores?

What do mushrooms have to do with decay?



GROUP II: MOLD MAKERS

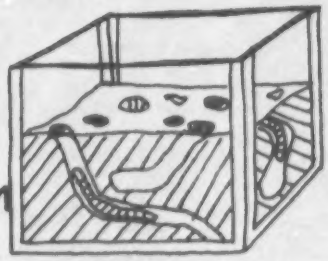
1) Put about one inch of sand in your terrarium.
2) Moisten the sand with water but do not make it too wet.
3) Put the pieces of kitchen scraps on top of the sand.
4) Cover the top. (Examples: orange, lettuce, bread, cheese, potato)
5) Check every few days to make sure the sand is wet. Pour a little more water in as it is needed.
6) After you have made your mold garden, have a contest. Each person in the group should write down which scrap he thinks will mold first.
7) Write down your guesses. See who wins the contest.
8) Record the scraps as they mold.

Name of Scrap	Date Scrap Molded

Library Exploring: What is mold?

GROUP V: WORM WATCHERS

1) Fill half your terrarium with soil.
2) Moisten the soil but don't make it too soggy.
3) Put in the earthworms.
4) Feed the worms with bits of lettuce, corn meal or other cereal mixed into the top of the soil.
5) Each person takes a week when he is responsible for keeping the soil moist and feeding the earthworms. He can feed them grass, leaves and celery as well as any of the food suggested in number 4, above. Take away any uneaten food when adding fresh food.
6) Keep the earthworm farm in a cool place. <u>Do not put it in the sun</u>.



Library Exploring: Why is the earthworm so important to the process of decay?

GROUP VI: BREADY BUNCH

1) Moisten 4 pieces of bread. Make sure that they are wet but not soggy.

2) Put each piece of bread into a plastic bag and close it tightly.

3) Put each bag in a different place in the classroom. (Hint: Put one bag in a warm spot, another in a cold spot, the third in a place that gets a lot of light, and the fourth in a dark closet.)

4) Look at the bread samples every day and record which one gets moldy first, second, third and last. Fill in the chart below.

Where we put the bread	What it was like there	Date the bread molded

More on Decomposition

Math/Science

Find a moldy piece of fruit. Put it in a covered container. Put in several fruits that are not moldy. Place some around the moldy piece and others away from it. Observe in a few days. How does the mold spread?

Lay a glass pickle jar on its side in a shallow box of sand. Put ½ inch of sand in the bottom of the jar. Cover with woody soil to the height of the opening. Add a few small rocks. Dig up some moss and press it into the sand in your jar. Water it and put on lid. Keep it in a shady place. Watch the moss grow.

Language Arts

Write a cinquain poem about mold.
A cinquain is a five line poem. The lines are organized in the following manner:

Line 1	one word	topic
Line 2	two words	describe topic
Line 3	three words	express an action
Line 4	four words	express feeling
Line 5	one or two words	refer back to topic

Art

Make a bulletin board showing the compost cycle (*garbage — compost — plant — food — garbage*). Illustrate each step and label it.

Group Activity

Make a landfill in a bucket by layering garbage alternately with soil. Be sure that your first and last layers are soil. Mark the top of the landfill on the inside of your bucket. On top of your landfill place small wooden blocks that have been marked to look like houses. Watch your landfill to see if the houses sink or twist as the garbage decomposes.

Take a trip to the city dump. Is it near water? How much does it cost to use the dump? Does the dump burn its garbage? What kind of things are found at the dump? How can the garbage pile be reduced? What things can be recycled?

Discussion

What would life be like if molds didn't exist? *Dead plants and animals would continue to pile higher and higher with no decomposition.*

Ecology Notebook

In your school or city library find the Life Nature library book *The Forest*, Peter Farb, Time Inc., 1963 or Our Living World of Nature Series, *The Life of the Forest*, Jack McCormick, McGraw-Hill, NY, 1966.
Look up to the section on decay and decomposition. Make a list of the steps of decomposition in the forest. List the animals, insects and fungi that contribute to the process.

Examine a modly piece of bread with a hand lens. Draw the mold.

Draw a diagram of the inside of an earthworm. Explain how it breaks down the materials that pass through its body.

Make a list of different kinds of fungi and draw them.

Make two columns on your paper. Head one *biodegradable* and the other *non-biodegradable*. List common items under the correct heading.

Compost

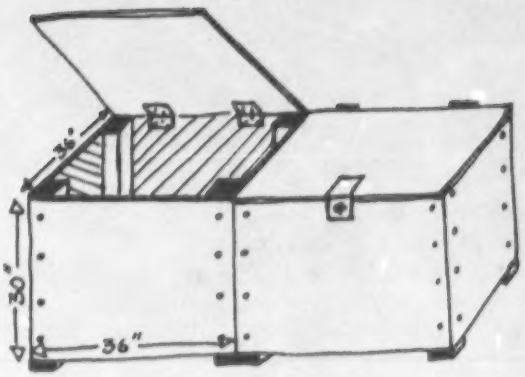
Objective
To demonstrate the role of natural decaying processes responsible for the conversion of organic garbage into useful garden compost.

Summary
Over a two-week period, students gather materials for composting, layer the materials in a compost bin, aerate the contents, and remove finished compost for garden use.

Key Words
aerate compost decay decompose
organic organisms

Advance Preparation
MATERIALS
2-unit compost bin
2 garbage cans with tight-fitting lids
plastic garbage can liners 2' 6" x 2' 1"
large shopping bag full of sawdust
pitchforks
organic garbage (1 garbage can full)
grass clippings
dry leaves
animal droppings
compost coloring book per child (included)
scientific thermometer (optional)

Construct a 2-unit wooden compost bin. Each unit measures approximately 36" x 36" x 30". Covers are necessary to keep moisture out and prevent heat loss.



Make arrangements for students to separate out organic (food) garbage during lunch period (meat and meat by-products should be avoided).

Teaching Suggestions
INTRODUCTION
Review decomposition's important role inthe life cycle. *See Forest Community — food cycle discussion.*

Explain to the children that they will participate in a useful method of disposing of garbage.

Pass out copies of Compost Coloring Book (masters enclosed). Go over each page with children to explain composting.

After compost is finished have a class discussion of its uses as mulch and/or soil conditioner.

PROCEDURE

Week one: Gathering materials for compost

Children take their garbage can (which is stored in the classroom) to the cafeteria. During the lunch hour, the "composters" separate food, paper and plastic as students dump their leftovers. Only foodstuffs go into the garbage can. After each day's collection, spread a 1" layer of sawdust on top of the garbage. Clamp the lid on tightly. Continue this procedure until the garbage can is full.

Have the children collect:

- grass clippings to fill 1 plastic garbage can liner 2' 6" x 2' 1"
- fallen leaves to fill 3 plastic garbage can liners 2' 6" x 2' 1"
- ¼ can of animal droppings, stored in tightly closed garbage can layered generously with sawdust.

Week two: Making compost

The children layer the collected materials in one of the bins in the following order: dry leaves, wet garbage, grass clippings and manure. Repeat the layering process until all the material is used. Sprinkle the pile with water until it is moist but not soggy.

Use pitchforks to transfer the contents from one bin to the other every day (this is called "turning the compost"). Students will be able to observe the heat generated by the compost by watching the steam it gives off or by sticking their hands in the pile. (Suggestion — Measure the temperature of the pile with a scientific thermometer.)

The compost should be ready at the beginning of the third week.

Background Information

The conversion of organic materials into simpler compounds suitable as soil conditioner or garden mulch is known as composting. This process is accomplished by bacteria, fungi, and other organisms which break down the more complex materials. In order to accomplish respiration, assimilation and building body tissue, these organisms need the carbon and nitrogen present in organic matter. However, for successful compost the carbon content must be far greater than the nitrogen, the ratio is approximately 30 to 1.

There are two methods of composting, aerobic and anaerobic. The former utilizes oxygen, and it is this type which is most suitable for a classroom project. The aerobic method is relatively odorless and breaks down very quickly.

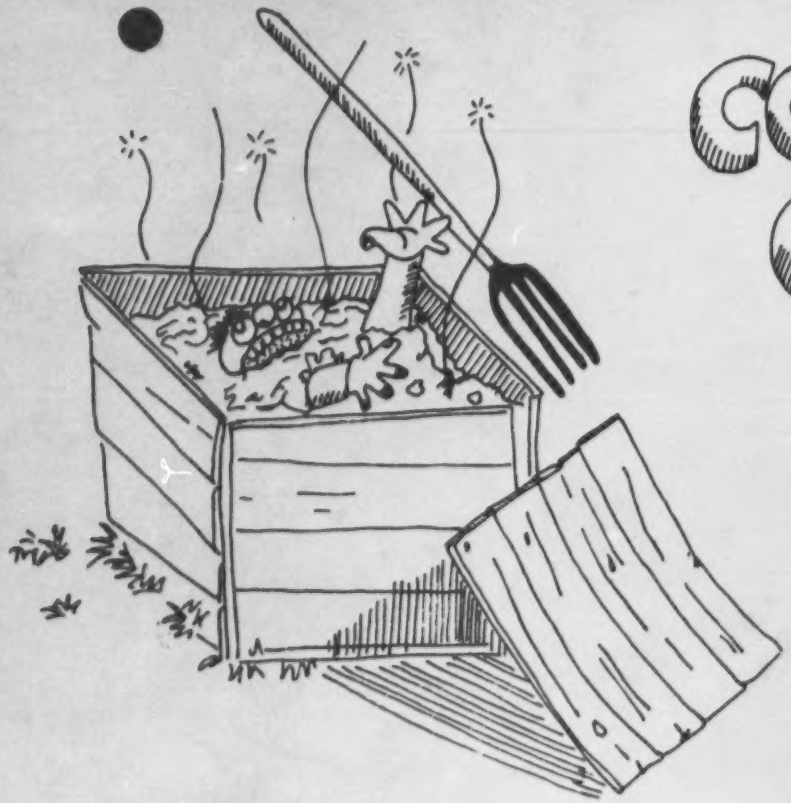
One of the most successful containers for compost is a wooden bin with two units to facilitate transfer or turning of the compost. Materials are gathered for composting and then layered in the bin. Matter high in nitrogen (grass clippings, foodstuffs and manure) should be alternated with carbon rich compounds (fallen leaves).

Due to the activity of the micro-organisms, the compost pile, particularly near the center becomes hot, reaching approximately 160 degrees during the first week. Because of this intense activity, it is necessary to aerate the compost, providing oxygen for the micro-organisms. "Turning" the compost from one bin to the other accomplishes this purpose.

Close attention should be paid to the compost pile. A strong ammonia smell means that the pile is too high in nitrogen in which case sawdust may be sprinkled while turning. On the other hand, failure to heat may indicate that the pile has insufficient nitrogen and additional manure may be added.

Within one to two weeks, the compost will cool. It can then be strained through chicken wire and spread on the garden plot.

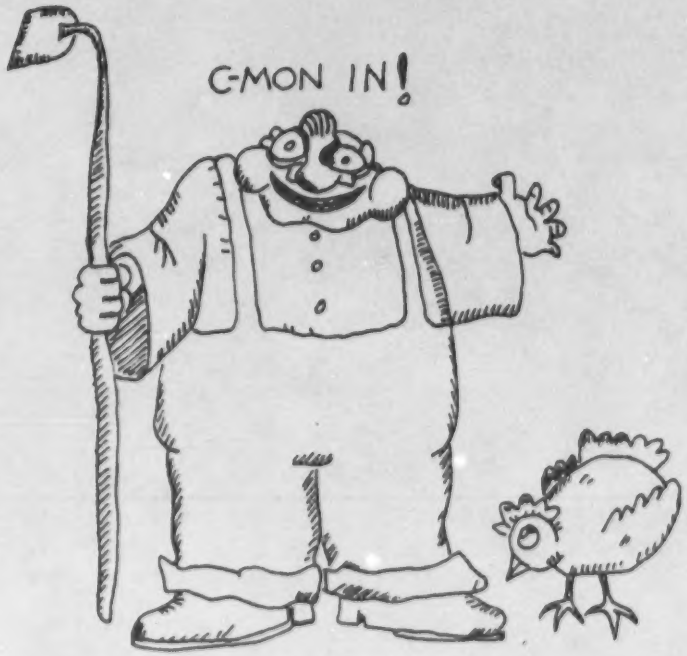
Besides demonstrating the process of decomposition, composting helps to maintain the balance in nature by eliminating waste and returning organic matter to the soil.

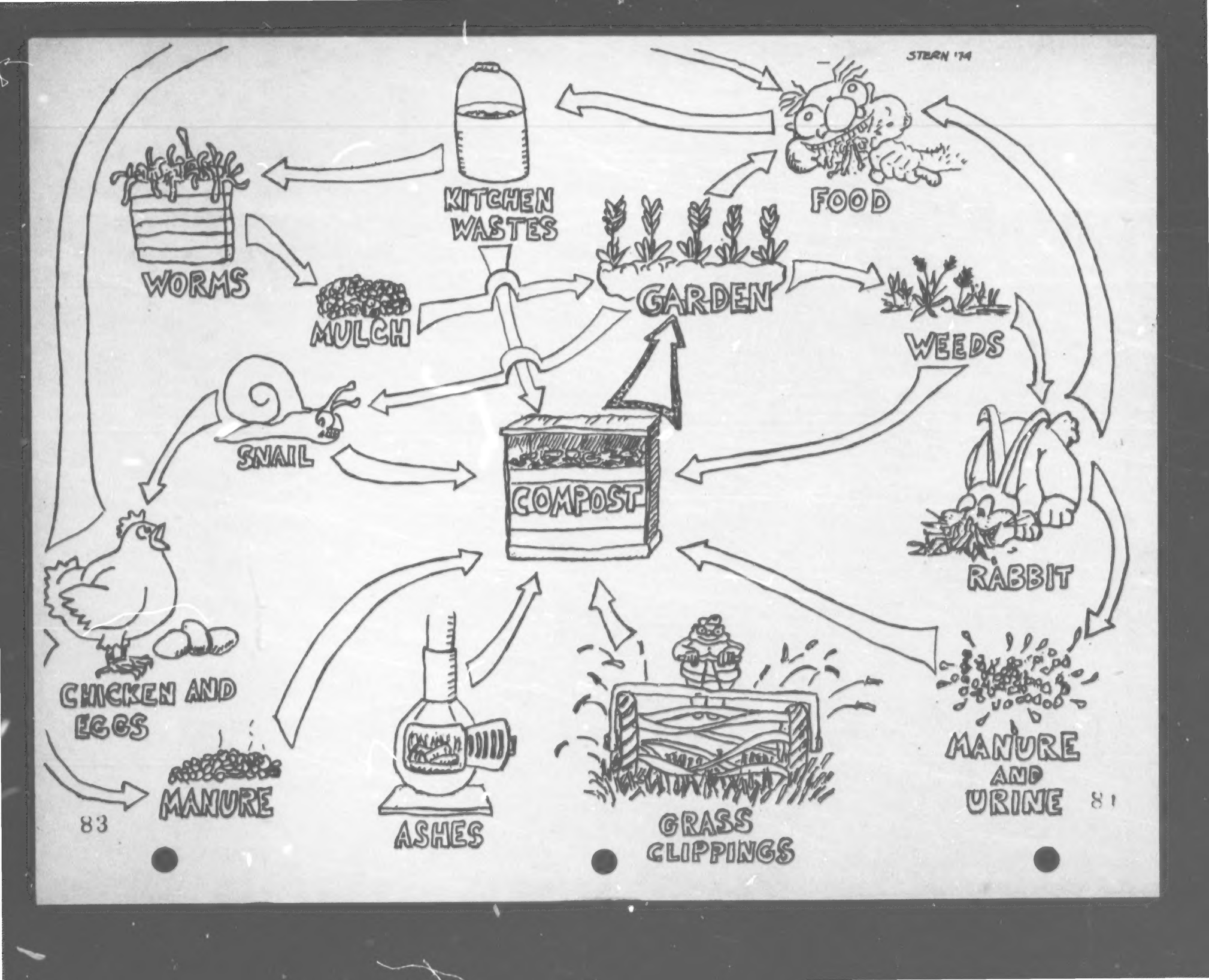


COMPOST COLORING BOOK

BY JOHN STERN '74

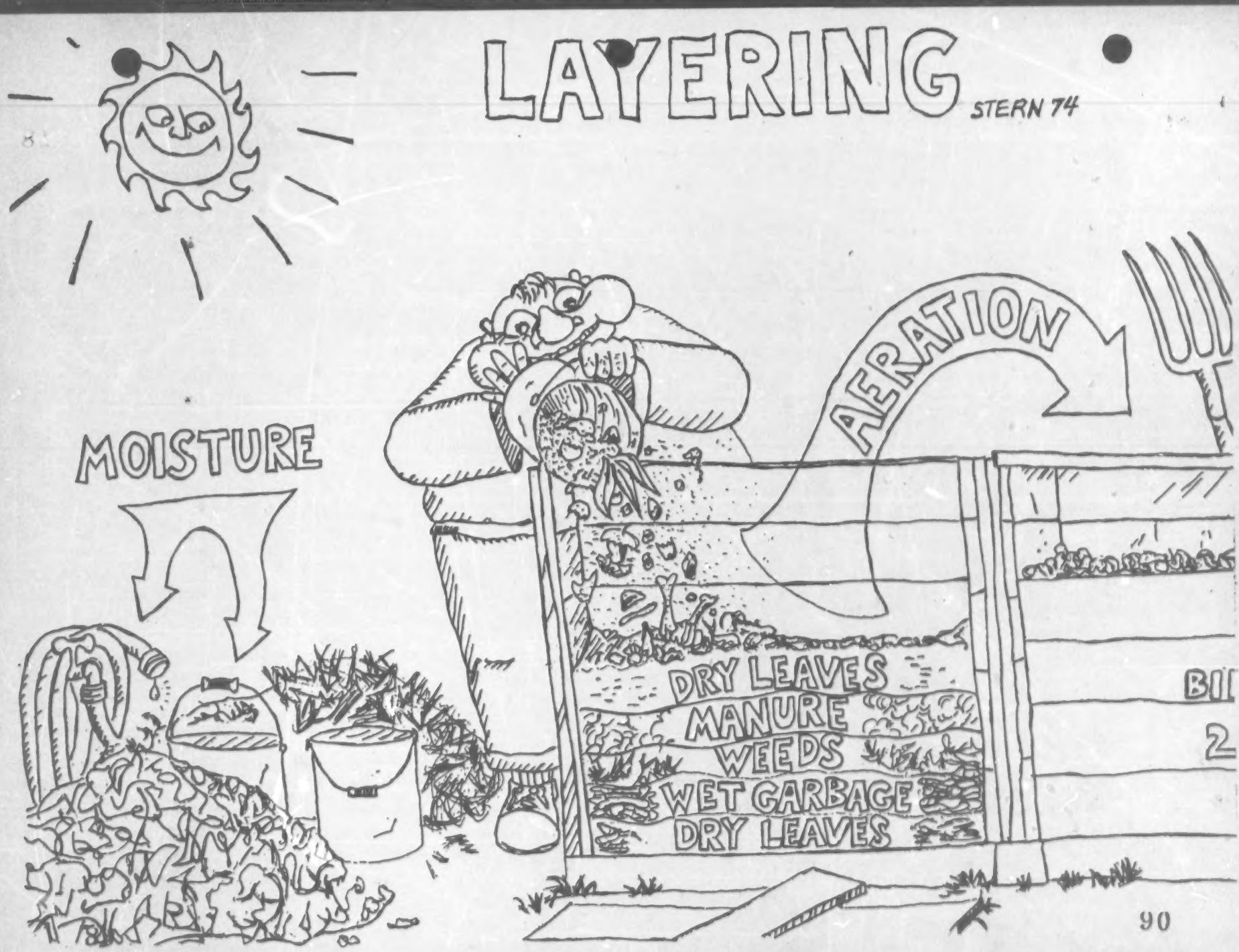
1. Waste Cycles
2. Kitchen Waste
3. Compost Components
4. Layering
5. Turning Compost
6. Composting Rates and C/N Ratio




STERN '74
KITCHEN WASTES
FOOD
WORMS
MULCH
GARDEN
WEEDS
SNAIL
COMPOST
RABBIT
CHICKEN AND EGGS
MANURE
ASHES
GRASS CLIPPINGS
MANURE AND URINE
83
81

SAWDUST
KITCHEN
WASTES

DRY LEAVES
KITCHEN GARBAGE
PEAT
GRASS CLIPPINGS
STERN '74
87
BIN 1
BIN 2
WEEDS
MANURE
OAT STRAW


LAYERING
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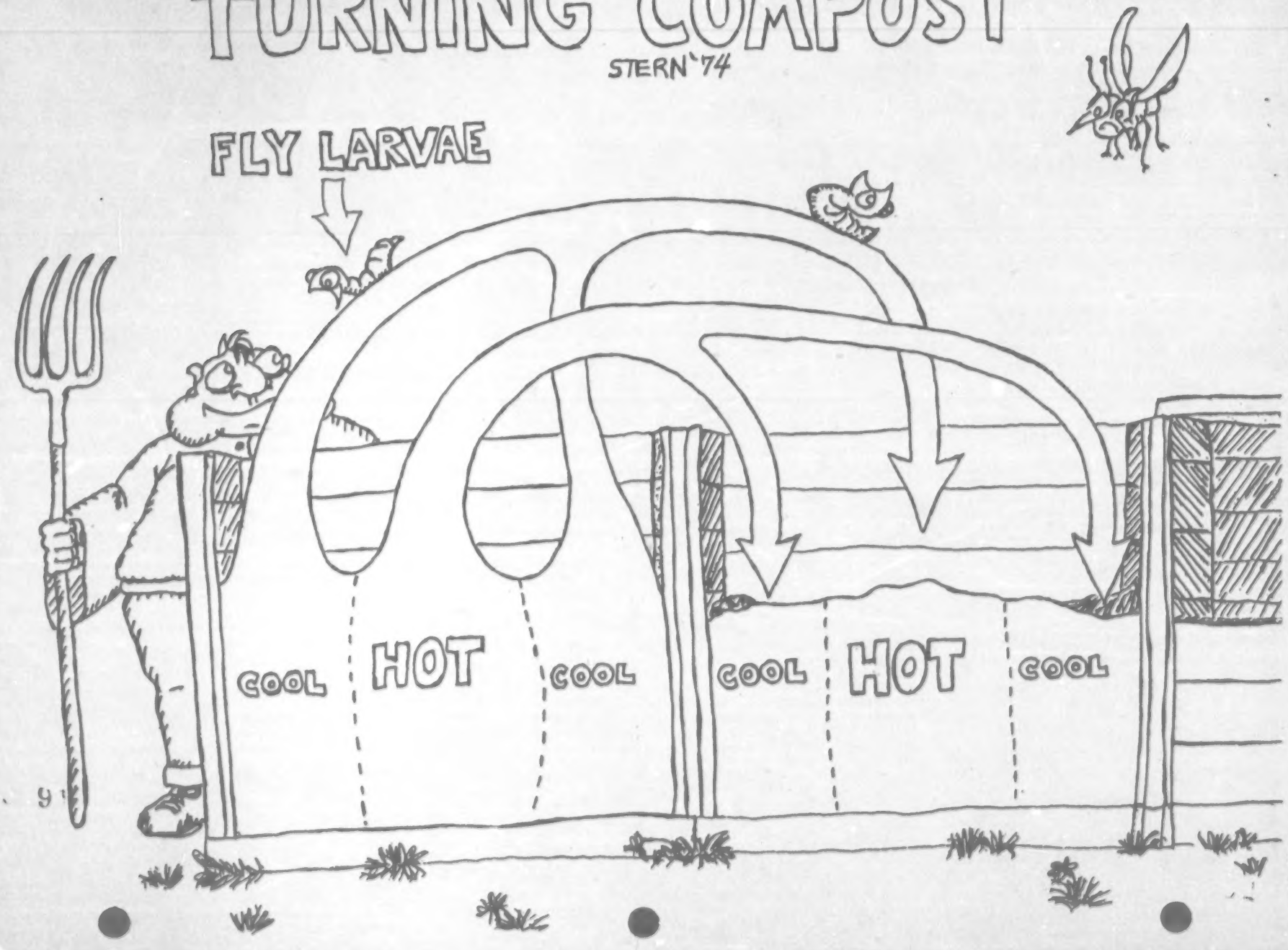
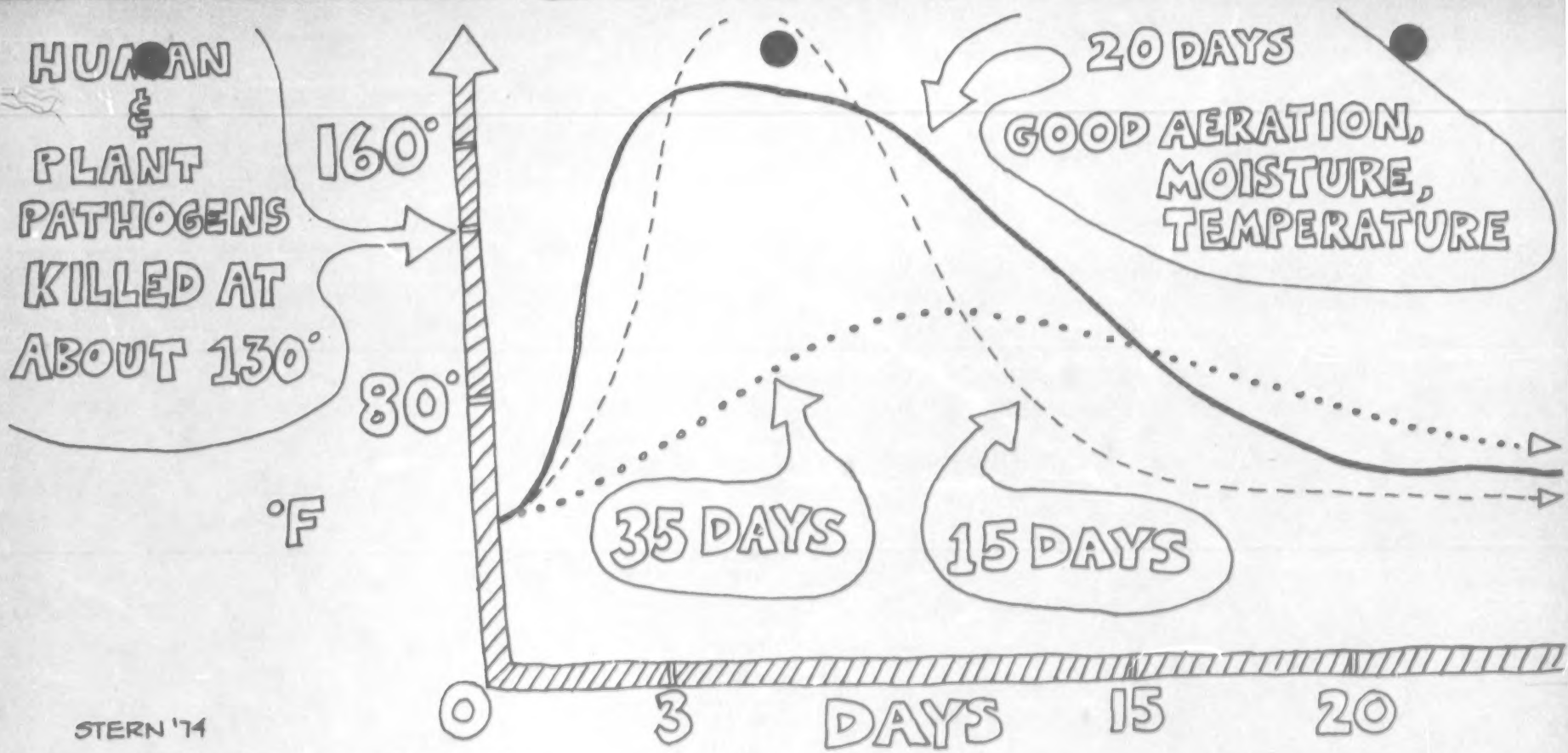
TURNING COMPOST

STERN '74





C/N	TIME	'N' BALANCE
20/1	15 DAYS	LOST NITROGEN SMELL AMMONIA
30/1	20 DAYS	CONSERVED NITROGE
60/1	35 DAYS	GAINED NITROGEN

Adaptation

Objective
To show how plants, animals and man improve their chances for survival by adjusting to changing physical conditions in their environments.

Key Words
adaptation camouflage environment
habitat protective coloration survival

Summary
The class explores animal adaptation by looking at and discussing a picture book on animal camouflage. They experience man's unique use of his thumb and forefinger by taping the two together and performing various tasks. And they imagine and draw a picture of an unusual animal, the *Sea Cucumber*, based on a description of its adaptive features.

Advance Preparation
MATERIALS
masking tape
drawing paper
crayons

picture book on animal camouflage
(Two excellent books are: *How Animals Hide*, Robert McClung, Nat'l. Geog. Soc. and *Animal Camouflage*, Otto Von Frisch, Collins Publishers, Franklin Watts Internat'l. Library, 1973.)
Sea Cucumber Narrative (included)

Teaching Suggestions
INTRODUCTION
What does the word **adaptation** mean? *The way plants and animals change to fit into their environments.*
Discuss the adaptive features which have contributed to human survival. *Brain, speech, rotation of arm from shoulder (for spear throwing), upright position (frees hands for using tools), opposing thumb and forefinger (for manual dexterity).*

PROCEDURE
- After discussing human adaptive features, explain to the children that they will do an experiment to demonstrate the importance of their thumbs for survival.
- Tape each child's thumb and forefinger together so he does not have the use of his thumb. Ask the children to: button their shirts, tie their shoes, write their names on a piece of paper, etc.
- Gather the children into a reading corner where they can all see the book on animal camouflage.
- While showing the pictures, discuss how the animals have adapted to their habitats (environments) and how adaptation improves their chances for survival.
- Next, have them sit at their desks. Explain that you are going to describe an animal that most of them have never seen before which is well adapted to its home.
- Have them close their eyes and listen carefully to a description of the Sea Cucumber. Have them draw it in its habitat.
- When the drawings are completed, show them a picture of the Sea Cucumber.

The Sea Cucumber

To be read aloud to the class:

I am shaped like a cucumber.
I have a soft body with leathery skin.
I lie on my side.
I have long tentacles like tree branches around my mouth.
I lie on the bottom of the sea or crawl on seaweed.
I keep my body shape by blowing myself up with water.
I don't have gills but I can breathe through my tentacles.
I push my sticky tentacles outside of my body and collect whatever will stick to them. Then, one at a time, I slide them back into my mouth and lick them clean like a kid with jam on her fingers. Anything I can't eat goes right through me and out the other end. In fact, I pass about one to two hundred pounds of sand through my body each year.
I don't have any armour like my relative the starfish but I protect myself by making a poison which scares off or kills my natural enemies.
If I get bitten by an attacker, I turn myself inside out and wrap my tentacles around my enemy and escape, leaving my insides with him. I then crawl off and rebuild my insides at my leisure. This usually takes from one to three months.
Some people like to eat me. My poison doesn't hurt humans.

Background Information

Adaptation may be defined as — a structural or functional change permitting a species to adjust to its particular environment. In order to survive, plant and animal species must get food, protect themselves against enemies, and reproduce.

A plant may develop a unique water storing system which enables it to adapt to a hot, dry climate; or it may evolve a root and stem system which enables it to live underwater. To insure continuing reproduction in changing conditions, plant seeds may develop special ways of traveling that provide for wide dispersal.

Adaptive features in animals may be as varied as those of the Sea Cucumber, or as complex as the protective coloration of many species. Size, shape, coloration, skin coverings and many other features help animals adapt to their environments.

Man's brain and his muscle system make him unique. While animals are controlled by their environment, man has been able to alter his somewhat. Because of the tools he makes and the shelters he builds, man can adapt more quickly while it may take another organism several generations.

Whatever the habitat of the organism, the adaptive features are those which insure the best possible means of survival. Plants and animals which cannot adapt to a changing environment, do not survive.

More on Adaptation

Math/Science

Go to the library and collect information for a report on one of the following topics:

- Bird beaks — how they are suited to the birds' diet.
- Animal teeth — how they are suited to the animal's diet.
- Claws and feet — how they help animals survive.

Illustrate your report.

Obtain one or two chameleons for classroom study. Keep the chameleon in a terrarium, preferably with a heat lamp directed into the living area. Chameleons will only eat living (moving) prey such as meal worms and crickets. A flat stone with water drops sprinkled on it, a climbing stick and some dirt complete its home. Sprinkle rye seed on the dirt, then water, and in several days the grass will sprout. Observe how the chameleon changes colors as it moves from one area to another. Develop an observation chart which records:

- What does it look like?
- How does it move?
- What does it do?
- What does it eat?

- How does it protect itself?
- How old is it?
- How might it die?

(See Bug Eye chart in Schoolyard Eco-Systems unit.)

Language Arts

Invent an animal that lives in rock piles. Tell what it eats, how it catches food, and all the conditions it needs for survival.

Write a story called **"A Life Without Thumbs"**.

Art

Make a poster of a human foot surrounded by all the different kinds of shoes we have designed to suit our needs (i.e. sandals, hiking boots, skis, etc.)..

Invent a small animal who never moves. Draw a picture of him camouflaged in his environment. Design a weapon for him to catch his food and describe the food he eats.

Invent a plant or animal that is tractor proof.

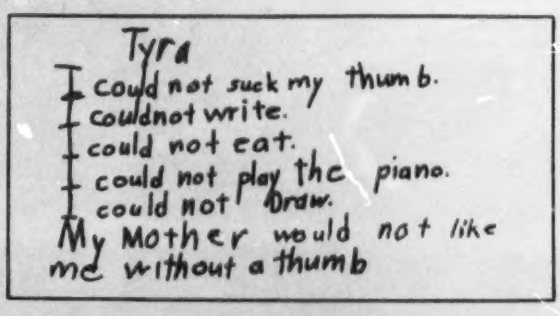
Group Activity

Toothpick Game

Mark off grass-covered rectangle of earth.
Stake or toss 250 toothpicks into the area:

- 50 red
- 50 blue
- 50 yellow
- 50 white
- 50 green

Give children a time limit (20 seconds) to gather as many toothpicks as they can. (Let each color represent a different animal.) At the end of the experiment, make a chart of the number of toothpicks of each color the children found. Have a discussion of what this tells us about protective coloration. Ask why the white toothpicks (i.e. rabbits) were not well-hidden in the grass. Where would they be better camouflaged?


Tyra
I could not suck my thumb.
I couldnot write.
I could not eat.
I could not play the piano.
I could not draw.
My Mother would not like me without a thumb

Discussion

Why do dandelions survive in unfriendly human environments?

Ecology Notebook

Design a room adapted for having fun.

Design a foot that is good for climbing, digging, and swimming. Now design a human shoe that can do the same.

Go to the library and read about the cockroach. Draw a picture of the cockroach and tell three things you learned about how it lives.

Collect seeds and scotch tape them in your notebook. Label the ones you know. Write about their adaptive features. How do the seeds get to their proper growing site? By traveling through the air, on animal fur, by birds, etc.? Explain your answer.

Pelicanplay

Pelacans are Beautiful
Pollution is no good
Pelacans hate fish full
of D.D.T

Becky

Endangered Species

Objective
To alert students to the problem of endangered species by relating it to adaptation and man's role in altering environments.

Summary
The class pantomimes the following four skits: "Dinosaur Days", "Down in the Bayou", "The Brown Pelicans' Scrambled Eggs", "Don't Fight All Forest Fires".

Key Words
adaptation endangered species environment extinct habitat pesticide survival

Advance Preparation
MATERIALS
4 skits (included)

Teaching Suggestions
INTRODUCTION
Review the meaning of adaptation: How do animals adapt? *Protective coloration, warning coloration, physical evolution.* What happens to animals that can't adapt to their environment? *They become extinct.* For what other reasons might animals become extinct? *Loss of habitat, insecticides-pesticides, over-fishing, excessive killing.* What do we call animals that are threatened with extinction? *Endangered species.*
Can you name any endangered species?

PROCEDURE
Either the teacher reads the plays, or the class divides into four groups and one member of each group reads while the others pantomime.

If the children read the scripts, give them time to practice the text.

Examples of Endangered Animals

ostrich	yak
egret	sea otter
gorilla	blue whale
manatee (sea cow)	ferret
California condor	jaguar
spider monkey	bald eagle
tortoise	whooping crane
kangaroo rat	ocelot
alligator	tiger
crocodile	timber wolf
penguin	trumpeter swan

Down in the Bayou
CHARACTERS
Old Alligator
3 Young Alligators
2 Fish
2 Turtles
Hunter
Game Warden

"We are friends to many water animals," said the **old alligator** as he told his story, "but humans won't let us live in peace!"

"We **alligators** live in the hot marshy swamps of the South, with the **fish** and the **turtles.** During

the winter we bury ourselves in the mud at the bottom of the pond and hibernate. When spring comes we leave our holes and come out of the pond to mate. In a dry year, there isn't much rain and the pond dries up, so the turtles and fish live in our holes because they're still full of water. This is how we help our pond friends.

"We would be very happy and content in our pond, but along comes the **hunter.** He wants to kill us so he can have our hides for purses, belts and shoes. Here he comes now! Look how quietly we lie as he stalks around the edges of the pond. The **turtles** and **fish** are swimming around . . . maybe he'll think we're just old logs. Oh, look! He fired his gun and one of the **alligators** has been shot. Now he drags it out of the pond.

"But just in time — here comes the **Game Warden.** He stops the **hunter** and makes him pay a big fine. So you see, not all people are enemies to us. What the hunter did is now against the law and some people are setting aside swamps just for us to live in. Maybe there is some hope for us after all."

Dinosaur Days

CHARACTERS
3 Fern Plants
4 Plant-eating Dinosaurs
2 Meat-eating Dinosaurs

Picture a swamp about 100 million years ago. It is a strange and mysterious place where lovely green **fern plants** grow along the water's edge, bending and stretching. There are other things living here, too. From behind the trees come the big, clumsy **dinosaurs** with little bitty brains the size of walnuts. Their brains are so small they can hardly think! Look how dumb they are! They trip and stumble along, eating at the plants as they go.

The **dinosaurs** better watch out, though, because hiding behind the trees are ferocious **dinosaurs,** just waiting to eat up the dumb plant-eaters. These big ones have sharp teeth and powerful claws! Just look what happens . . .

And this is how they lived for millions of years until the weather began to change. It got so hot that the swamps dried up. The **plants** began to gasp and wither, falling dead everywhere. The pea-brained **dinosaurs** came looking for food and saw the plants were gone — they could not adapt to life outside the swamp, so very slowly, they began to stumble and fall, and at last — heaving a sigh — they dropped dead!

Now thundering out from behind trees came the giant meat-eating **dinosaurs,** all angry because they were hungry. But what is this? Their prey was dead, and now they, too, began to crash to the ground — dead. So now all was still in this strange land — the giant beasts with the small heads were now extinct.

Don't Fight All Forest Firest

CHARACTERS
4 Kirtland's Warblers
3 Pine Trees
Forest Fire
Ranger

In a pine forest, there lived a flock of birds named **Kirtland's warblers.** They chirped as they flew among the **pine trees,** they sang and sang — loud and clear their song rang through the forest.

In the fall they flew south, in the spring they flew north and lived among the young pines that swayed in the wind. Now these warblers are very particular birds! They can only make their nests in forests of young pine trees. These trees grow up after a forest fire. As you might guess, the pine trees and the warblers need each other very much!

A short time ago, a big **forest fire** burned through some of the forest, then baby pine trees grew up all over. But then the **Ranger** came and put out these forest fires. The **warblers** stopped singing, and this is why: with no more forest fires, there weren't very many baby pine trees, so the **warblers,** being very particular, couldn't lay eggs.

Then the Rangers tried an experiment. Instead of putting out the Big Fire, they just went around it and made sure it didn't hurt anyone. This worked pretty well because, believe it or not, forest fires are not always bad — as the warbler will tell you.

Now in some places the Ranger just puts out man-made forest fires, and lets lightning fires burn. In these forests, the warblers are very happy — they sing all day as they fly among the young pines.

The Brown Pelicans' Scrambled Eggs

CHARACTERS

4 Brown Pelicans
Mother Milly, the biggest Brown Pelican
3 Pelican Eggs
Factory Worker
Government Person

Off the coast of the United States there lived a flock of birds called **Brown Pelicans.** They were beautiful birds who sat on the docks and cleaned their feathers and looked very proud because they had such beautiful long beaks. Their life was easy — all they did was fly around and look for the **fish** that were swimmng around in the sea below.

One day, **Mother Milly,** the biggest brown pelican, flew over to her eggs and sat down. Suddenly she let out a loud scream! "What has happened?" she cried. "My eggs are all soft and have cracked too soon!"

One by one the other mother pelicans flew to their nests and saw that the same thing had happened to their eggs. They all began to flap their wings and fly around in great distress. "Oh no," they cried, "no babies are being born — the pelican race is going to die out!"

The cause of this was soon learned. Way up the river was a big factory. Each day the **factory worker** brought a chemical called D D T and dumped it into the river. This DDT is what farmers put on their crops to kill insects. He just kept right on dumping, and it flowed down the river and into the ocean. The fish who were swimming around ate plants that had DDT on them. It didn't kill the fish, but they choked a lot. The pelicans ate the fish and the DDT got in them and made them lay soft eggs.

But just as the pelicans were getting so upset, something good happened. A **government person** came along and shook his finger at the factory worker. The factory worker had to stop dumping the DDT, and now the pelicans flew around and were happy again because nice little baby pelicans were hatching out of the eggs.

Background Information

A plant or animal species becomes endangered when its population has decreased to the point where it is threatened with extinction. Continuation of a species depends on the maintenance of adequate numbers. Animal species such as wolves need only one pair in order to reproduce. On the other hand, penguins need to live in flocks. Whales may need only one pair to reproduce, but when their populations decrease, they have difficulty finding a mate in the huge territory they roam.

Animal populations are part of the life cycle, and the elimination of any one species may affect the population of interdependent species. For example, pollution in a pond can reduce the number of frogs living there. This results in an increased insect population which may in turn effect crops.

In the United States alone, at least 109 species are in danger of extinction. The greatest cause of decreasing animal population is loss of habitat due to land development. Towns, suburbs, shopping centers, paved roads and parking lots have decreased the area in which animals may live. Many birds have lost their nesting places, larger animals their grazing land and forest animals their shelter.

Some persistent pesticides, such as DDT, have entered the food chain through the water, and have softened the eggs of some fish-eating birds so as to reduce reproductive success *(Brown Pelicans).*

Hunting has been a major factor in the extinction of some species. For example, the passenger pigeon, once great in number, was hunted for sport until the *last* one was shot. Other animals hunted for their pelts (*fur seals*) are now nearing extinction. Whales have been placed on the endangered species list because of over-hunting.

Laws against hunting have been enacted to protect endangered species of wildlife. Some pesticides have been banned and natural habitat reserves and zoos have been set aside to protect endangered species (not all will mate under the latter condition). Some animals (*trumpeter swan*) have now been brought back from the brink of extinction.

More on Endangered Species

Math/Science

Research an endangered species. Make a graph plotting its declining population. On the vertical axis plot the animal population. On the horizontal axis plot the dates.

Language Arts

Write *cinquain poems* about endangered species.

Line 1	one word	topic
Line 2	two words	describe topic
Line 3	three words	express action
Line 4	four words	express feeling or describe topic
Line 5	one or two words	refer back to topic

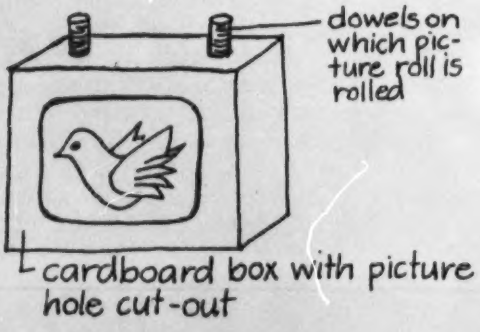
Pelican
brown feathers
wading in water
cool and dripping wet
proud bird.

Working in pairs, do skits for the rest of the class. One person will be a human, the other an animal in the zoo. The two have a conversation during which they tell each other about their lives.

Art

Do a full scale drawing of a dinosaur on a school wall. In the dinosaur's stomach picture other animals that have become extinct.

Make a cardboard box television report showing the life of an endangered species (see diagram).



Make a dinosaur foot in plaster or clay. The foot should approximate actual size. In using plaster it will be necessary to pour the plaster into a cardboard frame.

Group Activity

Assign the children to watch a T.V. program about endangered wildlife (*i.e.* Wild Kingdom, Jacques Costeau, National Geographic). Have a discussion about the program in class.

Have the class choose one of the national endangered species and organize a campaign to save it from extinction. The campaign might include the following activities:

- Coin a name for your campaign.
- Write a skit about why it is endangered, and present the skit to other classrooms.
- Make a class album.
- Have a letter writing session to inform congressmen about this issue.
- Go on local radio and talk about this issue.

Discussion

Make up riddles about endangered species:
I am a wild animal who lives in the Western part of the United States. I was brought to America by the Spanish. Some of us escaped and travelled in wild herds. Indians captured us and used us for transportation. Now people capture and kill us for dog food. Who am I? *Wild Mustang.*

Do you think an effort should be made to save endangered species? What about those that have trouble adapting?

Some people say that human beings are now an endangered species. Do you agree? If so, who and what is responsible for making them endangered?

What actions of people increase some animal and plant populations. *Banning ocelot coats.* What actions of people reduce some animal and plant populations? *Shooting wolves.*

Ecology Notebook

Write to the ELSA WILD ANIMAL APPEAL
P.O. Box 4572
No. Hollywood, Ca. 91607
They are working to preserve the environment and protect wildlife. Find out how you and your class can join their club and help endangered animals.

Find out which plants are endangered and why.

Pick an animal that is extinct. Why has it become extinct? What adaptations might have allowed it to survive? Draw a picture of the changes you would make to allow it to survive and explain them.

Do you think the cockroach will ever be an endangered species? Why or why not?

Foods

Objective
To encourage the use of unprocessed foods in diet, to become aware of foods from different cultures and to consider waste in packaging.

Summary
Children prepare natural food dishes and share them with the rest of the class.

Key Words
additive natural food preservative protein

Advance Preparation
MATERIALS
See individual recipes.

Teaching Suggestions
INTRODUCTION
What is a natural food? *A food that is unprocessed and as close to its natural state as possible.* What is processing? *Canning, preserving, homogenizing, adding artificial coloring and flavoring, etc.* Why are foods processed? *To prevent spoilage, to make them look better, convenience, etc.* What is good about processing foods? *Same as above.* What is bad about processing foods? *Costs more, uses more energy, creates more waste from excess packaging, health effects of chemical additives unknown, etc.*
We know that many people in other countries do not eat meat. Do you know why? *Farmers must buy grain to fatten animals. This grain might otherwise be eaten by humans. It takes many pounds of grain to make one steak.*
Explain to the children that they will be making and tasting some foods from other countries.

PROCEDURE
Prepare foods following directions on individual recipes.

MIDDLE EASTERN VEGETABLE DIP

Utensils
measuring cup
tablespoon
bowl
spoon
knives
cookie sheet

INGREDIENTS
½ C. yogurt
½ C. mayonnaise
1 T. dill
1 T. beau monde
1 green onion, sliced thin
1 bunch carrots
½ cauliflower

- Cut up carrots and cauliflower into bite-sized pieces for dip.
- Mix yogurt, dill and beau monde together in a bowl.
- Chop green onion and add to mixture.
- Get mayonnaise from mayonnaise group and add to mixture.

Put carrots and cauliflower on cookie sheet with the bowl in the middle. Dip vegetables in dip and taste.

MEXICAN SOYBEAN SPREAD

Utensils

bowl
forks
mixing spoon
knives
teaspoon
cookie sheet

Ingredients

1 C. soybeans (soaked overnight and simmered for 2 hrs.)
½ C. mayonnaise
small green onion
½ t. salt
crackers

- Wash hands.
- Put soybeans in bowl and mash well with forks.
- Add mayonnaise to mixture.
- Chop onion into small pieces and add to mixture with ½ T. salt.
- Spread soybean mixture on crackers.
- Place crackers on tray and serve to class.

EARLY AMERICAN MAYONNAISE

Utensils

electric beater
measuring cup
measuring spoons
bowl

Ingredients

1 egg
1 T. lemon juice
½ t. salt
¼ t. mustard
½ C. oil

- Wash hands.
- Break egg into bowl and beat with electric beater *just a little.*
- Add lemon juice, salt and mustard to egg.
- Beat for *just 5 seconds.*
- Pour the oil into the egg mixture *a few drops at a time.* Everyone can take turns beating the mixture while someone is adding the oil.
- When you have added all the oil and you have thick mayonnaise, take it to the people making the vegetable dip or soybean spread.

JAPANESE SUSHI NAGIRI

Utensils

bowl
grater
cookie sheet
shallow dish

Ingredients

1 C. cooked Japanese rice
2 sheets dried seaweed
½ C. sesame seeds (roasted for 30 minutes)
¼ C. soy sauce
1 carrot

- Wash hands.
- Grate carrot.
- Tear up seaweed sheets into small pieces.
- Combine carrot, seaweed, rice and sesame seed in bowl.
- Take a small handful of mixture and squeeze to form a ball.
- Serve on cookie sheet.
- Dip into shallow dish of soy sauce before eating.

TABOOLI

Utensils

bowl
measuring cup
teaspoon
mixing spoon
knives
cookie sheet

Ingredients

1 C. dry bulgur wheat (Ala), (soaked in 2½ C. water for 1 hr.)
1 bunch green onions
2 tomatoes (if in season)
1 bunch of parsley
mint
juice of one lemon
¼ C. vinegar
½ C. oil
1 t. salt

- Wash hands.
- Chop onions, tomatoes, parsley, and mint into small pieces.
- Put bulgar wheat and onions in a bowl and mix well.
- Add chopped tomatoes, parsley, mint, lemon juice, vinegar, oil and salt and mix with a spoon.
- Put ½ lettuce leaf on cookie sheet for each student.
- In the middle of each lettuce leaf put a heaping tablespoon of Tabooli.
- Tell your classmates to roll up the Tabooli in their lettuce leaf and eat it.

FINNISH BERRY BANANA SHAKE

Utensils

big pot
tablespoon
measuring cup
egg beater
fork or potato masher
ladle

Ingredients

1 basket strawberries
6 bananas
4 T. honey
2 C. dry milk
4 C. water

- Wash hands.
- Wash strawberries and pull out stems. Peel bananas.
- Put strawberries and bananas in pot and take turns smashing with a fork.
- Add dry milk, honey and water.
- Take turns beating the shake until it is ready to serve.

Background Information

"Each being has only one body, and he may choose to nourish that body with the foods that grow in the earth, or he may choose to have someone else harvest the earthy food, process it, add chemicals to it ... preserve it, put it in a plastic bag, put that plastic bag into a box, cover the box with more plastic, put a fancy price on it, call it new, tell us it will taste good, and most incredibly, tell us it is food that will sustain our bodies when we eat it."

Ellen Buchman Ewald
Recipes for a Small Planet, p. 25

Today, about 75 cents out of every dollar spent in the American marketplace pays for the costs of packaging. In poor countries, and even to some extent, in European countries, consumers adjust their diets to seasonal production. With limited storage and refrigeration facilities, they shop often and buy locally grown produce. Shopping is a social event and the consumer may even buy directly from the producer. Because of our fast paced society, the consumer often pays two or three times the price of unprocessed foods for overpackaged convenience foods. Flashy packaging attempts to catch the consumer's eye, and often sells a product that might not otherwise be purchased. Convenience foods come in many forms such as frozen, pressurized, freeze-dried and instant, each calling for new and different types of packaging. Each in turn, requiring complicated and expensive equipment and increased handling at the "middle-man" stage. Further complications arise in the packaging industry due to the use of dissimilar materials in the manufacture of one container, such as a glass bottle capped by a metal top with a cork or plastic gasket.

While excessive food processing and packaging does have some advantages, such as sanitation and longer shelf life, it requires additional energy consumption to make and operate packaging machinery and results in increased solid waste problems generated by throw-away containers.

The United States has the highest agricultural production in the world, but is also the greatest consumer of the world's natural resources. While one-half of the world's population is undernourished, the average American eats 10 — 12% more protein than is required for good nutrition. Since 1940, American per capita meat consumption has

increased from 50 pounds of meat per year to 115 pounds per year, yet if we could diminish our consumption of meat by only 10%, 60 million people could be fed on the 12 million tons of grain saved from livestock consumption. Livestock must be fed 20 pounds of vegetable protein to produce one pound of meat protein. The waste resulting from this conversion factor in our country alone is equal to 90% of the world's protein deficiency.

At the present time the amount of land available for agricultural production in the world is equivalent to about one acre per person. It takes three and a half acres per person to support a meat and milk based diet, while only one-fifth of an acre per person to support a vegetable protein diet. While it is unrealistic to expect Americans to become vegetarians in the light of the world food crisis, awareness of American food production and packaging costs in both economic and resource consumption terms might be an incentive to watch more carefully what we buy and eat.

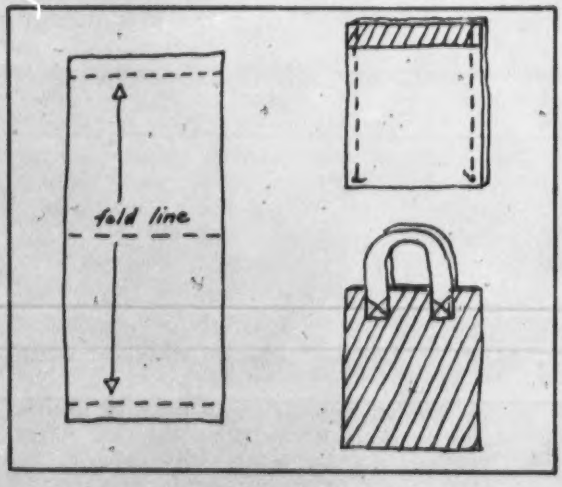
More on Foods

Math/Science

Try the following experiment:
Weigh yourself before lunch. Weigh all the edible parts of your lunch. Then weigh yourself after lunch. Did you gain the weight of your lunch? Try to draw some conclusions from your findings. *What other purpose does eating serve our bodies beside weight gain?*
Do the above experiment for a week and plot your findings on a graph.

Art

Make a reusable cloth shopping bag for a gift.



Make a food chain mobile for all the things you eat for breakfast, lunch or dinner. Example: *hamburger — cow — grass.*

Language Arts

Find a play about American Indians or Pioneers in the library. Working in class committees, make sets, costumes, choose the actors and invite your parents or another class to your production.

Group Activity

Have a *"Foods Around the World"* potluck using recipes from the students' ethnic backgrounds.

Make an exhibit of natural foods (i.e. foods without artificial additives) and foods invented by man (Baco-bits, Twinkies, etc.). Read the ingredients.

Make a list of basic foods such as flour, oil, rice, etc. Visit a supermarket. Find out the cost per pound or quart of each of your items. How much do you save by buying five pounds? How much more does the name brand item cost than the store brand item?

Discussion

Cut an apple into quarters and set 3 of them aside. The remaining quarter represents the part of the

earth's surface that is not under water. Next cut this quarter in half and set one piece aside. The piece in hand represents the part of the earth suitable for human habitation. The other part is too cold, too dry, or too mountainous.

Now cut the last ⅛ (which represents the part man can live on) into four equal slices. Rather thin, aren't they? Just one of these four small slices represents the part of the earth that supplies most of our food and clothing, the small part which is presently tilled. It is not too wet, not too poor, not occupied by cities, factories or highways.

From *Environment, A Way Of Teaching*, Alameda County, California, School Department.

Discuss the World Food Problem

Possible Topics:

- importance of grains — protein source
- cost of meat — animal grain consumption
- weather
- nutrition

Have the children pick the name of a product out of a hat (i.e. drugstore items, cereals, processed foods, etc.). Have them examine four examples of their product and compare packaging. Is all the packaging necessary? Does it affect the price of the product? (Fruit: dried, canned, fresh, frozen, etc.)

Ecology Notebook

Find out what foreign country your family first came from. Bring in a recipe and have the class make it. Make a book of all the recipes and sell it at a fair.

Find out which wild plants you can eat. Draw and label them and tell their uses.

Wheat

Objective
To demonstrate the importance of grains as a food source through a wheat planting project.

Summary
The children, working in four groups, perform the following tasks: select a garden plot, design a fence, plan the garden, and prepare a publicity campaign. Implementation and planting follow. The wheat will be ready to harvest in about six months (minimal maintenance required). After harvesting, the children grind their wheat into flour and bake bread.

Alternative: If no planting space is available, planter boxes may be used.

Advance Preparation
MATERIALS

4 activity sheets, one per group (included)
fence building materials
garden tools for preparing the soil
seeds (½ lb. will cover a 10'x20' plot)

Group I
Plotters
stakes
string
graph paper
colored pencils

Group II
Fencers
drawing paper
crayons

Group III
Planters
pencils, paper (optional)

Group IV
Publicity
pencils, paper (optional)

Get permission from the principal to plant a garden.

Teaching Suggestions
INTRODUCTION

Can you think of any animals besides cows, sheep, and goats that eat grass?

Did you know that human animals eat grass everyday? *Cereal is made from grass seeds; beef comes from cows that ate grass.* What is bread made of? *Wheat.* Wheat is just one of 6,000 varieties of grasses. Can you think of any other varieties? What other kinds of bread or cereals do you eat? *Rye, oats, corn and rice.*

Can you think of any other uses for grasses beside food? *Decorative, for lawns, parks, etc.; it holds and builds the soil.* Most flowers are brightly colored or fragrant to attract bees to pollinate them. Grass has small flowers that you hardly notice. Can you guess how grass is pollinated? *By the wind.* Have you ever seen wheat growing? Do you think we could grow it in the schoolyard?

PROCEDURE

If the children accept the challenge, explain that the project will need careful planning in order to be successful.

- Outline the activity for the children.
- Divide them into groups.
- Distribute work sheets.

Selecting A Site

Pick the spot that gets the most sun. It is better to plant in a sunny spot with greater exposure to human use (i.e. children and balls) than to plant in a protected, shady spot. Wheat can withstand some abuse and a small amount of foot traffic in its early period of growth.

Preparing the Soil
The soil should be spaded 8" — 10" deep, preferably a couple of weeks before planting to allow the first rains to soak in. (Compacted soil which has not been used for a long time will need to be turned by adults.)

Building a Fence
Recruit a parent or volunteer to supervise the fence building. Once the holes are dug and vertical posts are anchored securely in the ground, the children can help nail up the horizontal pieces.

Planting
Find out from your county Agricultural Extension Agent where to get wheat seeds and when the best time to plant is. In California, wheat is a winter crop and can be planted on the day before Christmas vacation. Because it is planted during the rainy season it will need no watering to germinate. The seeds may be broadcast, scattered or planted in rows.

Rows
Form ridges in the soil about 1 foot apart. Plant seeds in the ridges about 1" deep and 2" apart. Use the spaces between the ridges for walking.

Broadcasting
Scatter the seeds as evenly as possible over the bed. (The bed should be narrow enough to broadcast the seeds evenly.) Use a rake to cover the seeds with soil.
Do not walk over the bed or rows of wheat after you have planted. Provide ample space for walking around rows and beds. The wheat should begin to germinate in about two weeks. It needs no watering or other care.

During the growing season, the wheat can be the focus of many activities such as: plant cycles, measuring and graphing activities, study of varieties of grasses, history of cereals and grains, etc.

When the wheat is harvested invite a local baker to your classroom. Have him help you make bread, starting with grinding the wheat.
The project is also a great way of getting publicity for your school. Invite a local TV station or newspaper to report on your project.

Background Information

Grass is perhaps man's best plant friend. There are several thousand varieties of grass. Grasses grown for grain for human and animal consumption are called cereals. The most commonly grown cereals are: *wheat, corn, rice, rye, barley* and *oats*. Wheat, one of the world's most important grasses, has been eaten for over 6,000 years. In many countries, wheat is a staple and is the most commonly ground flour for bread. In Mexico, wheat and corn tortillas are an important part of the diet, while in India, wheat flour dough is used to make chapati, a flat bread.

Scientists are looking more and more to grains and legumes as a solution to the world protein problem. Since it takes 20 pounds of vegetable protein to make one pound of animal protein, it makes more sense to get protein directly from plants. By combining grains, legumes, seeds and dairy products in the right proportions, people can get the protein they require for good health.

Besides the possible role of grasses in alleviating the world food crisis, grains serve us in many other ways. For instance, cities and factories need huge quantities of water to function smoothly and well managed grasslands abosrb more rainfall than cultivated land and store it for future use underground. Around waterways, grasses prevent erosion and silting. Most agricultural production depends on grasses planted for soil conditioning and crop rotation. Industrial parks, shopping centers, parks and highways are landscaped with grasses and plants. "Open space" is being set aside to protect cities from overdevelopment and provide improved recreational facilities.

GROUP I: PLOTTERS

There will be enough wheat to plant a plot 10 feet by 20 feet. The plot should be in a sunny location but in a protected place.

Go outside. Select and mark the space that seems best to your group. Use stakes and string to mark the plot.

Make a map of your plot to put up in the classroom. Use a scale of 1 inch equals 1 foot. Show where the school building is on your map.

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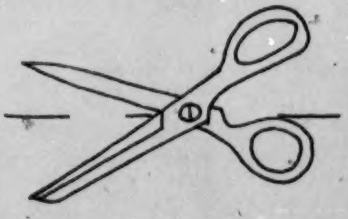


GROUP II: FENCERS

To protect the wheat plot we will need to build a fence. Design an easy to build fence that won't cost a lot of money. Draw a picture of it to put up in the classroom. Make sure there is a way to get inside of the fence without climbing over it.

Make a list of all the materials you will need to build the fence, including tools.

GROUP III: PLANTERS

There will be enough wheat to plant a plot 10 feet by 20 feet. There are two ways it can be planted:

a- You may plant in rows. Each row will be one foot away from the next one, or

b- You may broadcast the seed. (This means scattering the seed all over the plot, then going over it with a rake to cover the seed.

Decide which is the best way to plant it.)

Can you think of any other grains, vegetables or flowers you might like to try planting at the same time. (Remember – you will be planting in the winter.)

GROUP IV: PUBLICITY

In order to have a successful wheat project, all the children at the school must know what we are doing. Think of ways to tell the other children about the project.

Suggestions:

A puppet show or play

- What will the message of your puppet show be?
- Figure out the characters and their names.
- What will your stage and set look like?

Posters

- What will the posters say?
- Where will you display them?

More On Grains

Math/Science
Record wheat growth data on a graph. Have the vertical axis represent height and the horizontal axis represent time. Measure the height of the wheat every two weeks and plot it on the graph. Join points to form a growth curve. Try using metric measurements.

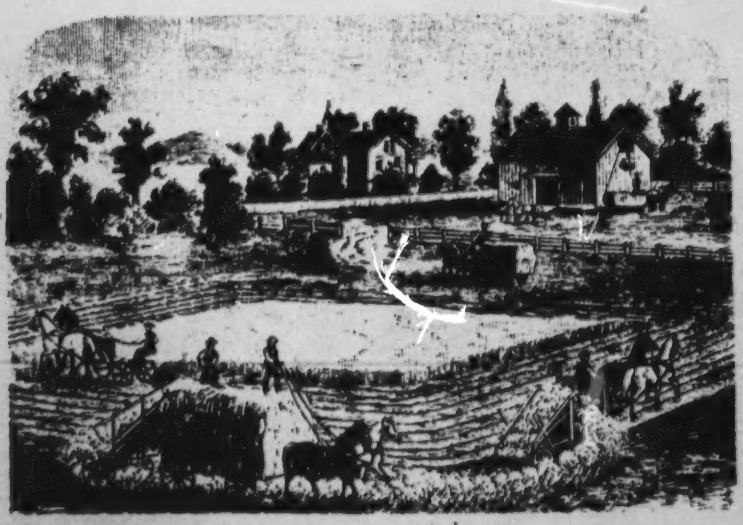
Language Arts
Research different harvest celebrations. When your wheat is ready, have a harvest festival.
Keep a class experience chart on the progress of the wheat. Invite the local newspaper to your harvest festival and ask them to write an article about the wheat project, using your experience chart for the article.

Art
Collect the dried grasses around the school or in the neighborhood and make a dry arrangement for the classroom.

Group Activity
Take a trip to your local bakery to see how bread is made.

Discussion
Have the children pick the name of a grain or other staple (potatoes, yucca, etc.) from a hat. Ask them to find out where it is grown and how it is used (i.e. soy beans = tofu, milk, etc.) and in what country it is a staple. Pick a time when they can all share what they have learned.

Ecology Notebook
Study breads from foreign countries. Tell about five of them and how they are made.



Scavenger Hunt

Objective
To evaluate what has been previously learned and to make the children aware of litter on the schoolyard.

Summary
Pairs of children are given scavenger hunt lists and bags to take outside. They are allowed 15-20 minutes to find the items on their lists. Children return to the classroom and go through the items together. Teacher should determine from this activity what children have learned from previous lessons.

Advance Preparation
MATERIALS
scavenger hunt lists (included)
bags (used)

Teaching Suggestions
INTRODUCTION
Discuss and review previous lessons. Ask children what a scavenger hunt is. Explain to the children that this is an opportunity to see what they have learned.

PROCEDURE
- Pass out scavenger hunt lists and bags to children and take them outside.
- Give them 15-20 minutes for the hunt.
- Call them back to the classroom.
- Read the items n the list one at a time and have the children hold up what they found.
- If they had trouble with any of the clues, refer back to previous lessons.
- Using the found items, have the children do a class litter collage that could be displayed in the hall for other students and teachers to see.

ALTERNATE PROCEDURE
(recommended for younger children)
- Pick about 10 clues from the list.
- Go over each with the class as a whole.
- After the children have solved the clues, pass out bags to pairs of children and send them outside to find the specific items they have named.
- Call them back to the classroom and let them share their findings with the others.

Possible answers to clues:

1 fruit peel
2 candy wrapper
3 can
4 plastic bag
5 paper
6 glass, pop-top
7 dead plant, molding food scrap
8 paper, can, bottle
9 leaf, soil
10 use your imagination
11 rock
12 soil, dead leaf, sun
13 glass, sharp plastic
14 plant
15 food scrap
16 air, sun
17 use your imagination
18 stagnant water, smog, cars

Scavenger Hunt List

Bring back only discards from man or nature. You can bring back an answer in your head that can't be put in your bag.

1- A natural food covering.
2- A man-made food covering.
3- Some man-made litter that came from mineral/rocks.
4- Some man-made litter that came from mineral/oil.
5- Some man-made litter that came from plants.
6- Something man-made that can cut your finger. (Be careful not to hurt yourself.
7- Something that is decomposing (decaying).
8- Something that could be recycled.
9- Something a worm might like to eat.
10- Something you could use in making a toy.
11- Something that's been there for 100 years.
12- Something that helps a plant to grow.
13- Something that could hurt an animal.
14- Something from the lowest link in any food chain.
15- Something that would mold.
16- Something that doesn't come from the earth.
17- Something hard, something soft, something smooth, something rough.
18- Look for a sign of water, air or noise pollution.

APPENDIX Forest Animals

BIRDS ON TWIG

Eat:
Plant-eating insects
Preying insects
Seeds
Spiders

EARTHWORMS

Eat:
Grass
Herbs
Leaves

CENTIPEDES

Eat:
Plant-eating insects
Preying insects

MILLIPEDES

Eat:
Grass
Herbs

BIRDS ON TREE TRUNK

Eat:
Nuts
Plant-eating insects
Preying insects
Seeds
Spiders

PREYING INSECTS

Eat:
Centipedes
Frogs and Toads
Millipedes
Plant-eating insects
Spiders

SPIDERS

Eat:
Centipedes
Millipedes
Plant-eating insects
Preying insects

BIRDS ON LEAF

Eat:
Plant-eating insects
Preying insects
Seeds
Spiders

TURTLES

Eat:
Earthworms
Fruit
Fungi
Leaves
Seeds
Plant-eating insect
Preying insects

PORCUPINES

Eat:
Bark
Buds and Twigs
Fruit
Herbs
Leaves
Nuts

RABBITS

Eat:
Bark
Buds and Twigs
Fruit
Grass
Herbs

FROGS AND TOADS

Eat:
Centipedes
Earthworms
Millipedes
Plant-eating insects
Preying insects
Spiders

DEER

Eat:
Buds and Twigs
Ferns
Fruit
Fungi
Grass
Herbs
Leaves
Nuts
Seeds

HAWKS

Eat:
Birds on Ground
Birds on Leaf
Birds on Trunk
Birds on Twig
Plant-eating insects
Preying insects
Rabbits
Shrews
Snakes

MICE

Eat:
Centipedes
Fruit
Herbs
Millipedes
Nuts
Plant-eating insects
Preying insects
Seeds
Spiders

MOLES

Eat:
Centipedes
Earthworms
Herbs
Millipedes
Plant-eating insects
Preying insects
Seeds
Spiders

RACCOONS

Eat:
Earthworms
Frogs and Toads
Fruit
Mice
Moles
Nuts
Plant-eating insects
Preying insects
Seeds
Shrews
Turtles

PLANT—EATING INSECTS

Eat:
Bark
Buds and Twigs
Ferns
Fruit
Fungi
Grass
Herbs
Leaves
Nuts
Seeds

BIRDS ON GROUND

Eat:
Buds and Twigs
Centipedes
Earthworms
Fruit
Nuts
Millipedes
Plant-eating insects
Preying insects
Seeds
Spiders

OPOSSUMS

Eat:
Birds on Ground
Birds on Leaf
Birds on Trunk
Birds on Twig
Fruit
Nuts
Plant-eating insects
Preying insects
Seeds

OWLS

Eat:
Birds on Ground
Birds on Leaf
Birds on Trunk
Birds on Twig
Hawks
Mice
Moles
Plant-eating insects
Preying insects
Rabbits
Shrews
Skunks
Squirrels

SNAKES

Eat:
Birds on Ground
Birds on Leaf
Birds on Trunk
Birds on Twig
Centipedes
Earthworms
Frogs and Toads
Mice
Moles
Plant-eating insects
Preying insects
Shrews
Spiders

BEARS

Eat:
Deer
Frogs and Toads
Fruit
Mice
Nuts
Plant-eating insects
Porcupines
Preying insects
Rabbits
Seeds
Shrews
Turtles

SKUNKS

Eat:
Birds on Ground
Centipedes
Frogs and Toads
Fruit
Herbs
Mice
Moles
Plant-eating insects
Preying insects
Snakes
Spiders
Turtles

BOBCATS

Eat:
Birds on Ground
Birds on Trunk
Birds on Twig
Hawks
Mice
Opossums
Owls
Porcupines
Plant-eating insects
Rabbits
Raccoons
Skunks
Squirrels
Shrews

SHREWS

Eat:
Centipedes
Earthworms
Frogs and Toads
Fruit
Herbs
Mice
Millipedes
Moles
Nuts
Plant-eating insects
Preying insects
Seeds
Snakes
Spiders

SQUIRRELS

Eat:
Bark
Birds on Ground
Birds on Leaf
Birds on Trunk
Birds on Twig
Buds and Twigs
Ferns
Fruit
Fungi
Herbs
Leaves
Nuts
Seeds

FOXES

Eat:
Birds on Ground
Deer
Frogs and Toads
Fruit
Mice
Opossums
Porcupines
Plant-eating insects
Rabbits
Shrews
Skunks
Snakes
Squirrels

APPENDIX Forest Plants and Animals

BARK

BEARS

BIRDS ON GROUND

BIRDS ON LEAF

BIRDS ON TREE TRUNK

BIRDS ON TWIG

BOBCAT

BUDS AND TWIGS

CENTIPEDES

DEER

EARTHWORMS

FERNS

FOXES

FROGS AND TOADS

FRUIT

FUNGI

GRASS

HAWKS

HERBS

LEAVES

MICE

MILLIPEDES

MOLES

NUTS

OPOSSUMS

OWLS

PLANT-EATING INSECTS

PORCUPINES

PREYING INSECTS

RABBITS

RACCOONS

SEEDS

SHREWS

SKUNKS

SNAKES

SPIDERS

SQUIRRELS

TURTLES

APPENDIX Alternate Food Web

SPIDER

Eaten by:
Birds on Twig
Raccoon

LEAVES

Eaten by:
Earthworm
Porcupine

SKUNK

Eats:
Centipede
Herbs

SHREW

Eaten by:
Raccoon
Bear

OPOSSUM

Eaten by:
Bobcat
Eats:
Fruit

RABBIT

Eats:
Grass
Eaten by:
Hawk

BOBCAT

Eats:
Mouse
Opossum

CENTIPEDE

Eaten by:
Skunk
Frog

BEAR

Eats:
Shrew
Deer

MOLE

Eaten by:
Owl
Eats:
Earthworm

FROG

Eats:
Centipede
Preying insect

SEEDS

Eaten by:
Birds on Ground
Birds on Twigs

BIRDS ON GROUND

Eat:
Seeds
Preying insects

SQUIRREL

Eats:
Fruit
Eaten by:
Owl

FOX

Eats:
snake
Mice

RACCOON

Eats:
Shrew
Spider

EARTHWORM

Eats:
Leaves
Eaten by:
Mole

BIRDS ON TWIGS

Eats:
Seeds
(Spider) insects

MOUSE

Eaten by:
Fox
Bobcat

DEER

Eaten by:
Bear
Eats:
Grass

HAWK

Eats:
Rabbit
Snake

OWL

Eats:
Squirrel
Mole

GRASS

Eaten by:
Deer
Rabbit

HERBS

Eaten by:
Porcupine
Skunk

*** EARTHWORM**

Eaten by:
Frog
Mole

PREYING INSECT

Eaten by:
Birds on Ground
Frog

PORCUPINE

Eats:
Leaves
Herbs

SNAKE

Eaten by:
Hawk
Fox

FRUIT

Eaten by:
Opossum
Squirrel

*** FROG**

Eats:
Earthworm
Preying Insect

GLOSSARY

Adaptation — The way a plant or animal changes to better adjust to its environments.

Addidtive — A chemical added to food for preservation, taste and color.

Aerate — To add air, as in aerating compost by turning it.

Biodegradable — Anything which will decompose.

Camouflage — The ability to disguise by blending into the background.

Carnivore — Flesh-eating animal.

Community — A group of plants and animals that live together and coexist in a defined area.

Compost — A mixture of decayed natural materials containing carbon and nitrogen used for mulch and aeration of the soil.

Cycle — A wheel that has no beginning and no end; a series of changes regarded as leading back to its starting point.

DDT (Dichloro-diphenyl-trichtoro--ethane) — An insecticide used to kill agricultural insects.

Decay — Rot.

Decompose — To decay, rot, break down, go back into the earth.

Decomposer — Any living organism that helps to break down dead plants or animals into minerals.

Deink — Removal of coatings, ink, glue and staples during the process of recycling paper.

Earthworm — The worm most commonly found in the garden.

Ecology — The study of the interrelationships between plants, animals and their environments.

Ecosystem — An area of interaction between plants, animals and the environment in which they live.

Endangered Species - A species which is in danger of becoming extinct.

Energy — The ability or capacity to do work.

Environment — All external conditions which affect the life and development of an organism.

Extinct — A plant or animal species that has died out.

Food Chain — A chain that links each animal to an animal or plant that it eats; a food chain must always end with a plant.

Food Cycle — The continuing process by which plants are food for animals which then die, decay and become food for new plants.

Food Web — The interdependence of plants and animals in a community for the purposes of obtaining food.

Fossil Fuels — Petroleum, coal and natural gas formed by the earth from dead plants and animals.

Fuel — Any substance used to produce energy.

Fungi — Plants without flowers, leaves, or green coloring matter which feed off living or dead plants and animals.

Habitat — The place where an animal or plant naturally lives or grows.

Herbivore — Plant-eating animal.

Interdependence — Mutual dependence, dependence on each other; when animals and plants depend on each other for survival.

Landfill — Layers of compacted garbage and soil ending with soil on top for the purposes of getting rid of garbage and creating useful land space.

Lichen — A dry looking, flowerless plant that grows like a patch of skin on rocks, trees, and other surfaces; lichens are decomposers and are grey, yellow, brown, black or greenish in color.

Machine — A device with moving parts capable of doing work.

Mildew — A kind of fungus that appears on plants or on paper, clothes, leather, etc., during damp weather; mildew is a decomposer.

Mineral — Natural substances of definite chemical composition that make up the rocks of the earth (e.g. sulfur, metals, petroleum).

Mold — A wooly or furry growth, often greenish in color, which appears on food and other animal or vegetable substances when they are left in a warm, moist place; mold is a decomposer.

Natural Food — Any food not treated with harmful chemicals

during growing and after harvesting.

Natural Resource — Any material supplied by nature such as rocks, minerals, petroleum, plants, animals, wind, sun, water and soil.

Niche — The role an organism plays in its habitat.

Omnivore — Flesh and plant eating animal.

Organic — Pertaining to or derived from living or once living organisms; compounds of carbon.

Organism — Any living thing such as any form of plant or animal life.

Pesticide — A chemical used to control crop pests (rodents, insects, fungi).

Petroleum — An oily, flammable liquid found in the upper strata of the earth used for making gasoline, plastics, fertilizers, detergents and other products.

Pollution — Dirt or waste in the form of invisible gasses and small particles in the air, chemical damage of the soil and water and blatant litter anywhere.

Power — Force or energy applied or applicable to work.

Preservative — Any substance used in treating food to retard spoilage.

Preying Insects — Insects that feed on other insects and animals.

Protective Coloration — The way an animal protects itself by camouflage or mimicry.

Protein — Amino acids in food which the body needs to exist.

Pulp — The mixture of rag or wood fibers of which paper is made when ground up and suspended in water.

Recycle — To put through the cycle again; to remanufacture or reuse.

Scavengers — Animals that feed off the remains of dead animals.

Smog — Air pollution consisting of a mixture of smoke and fog.

Solar Energy — Energy derived from the sun.

Solid Waste — Garbage, trash, litter, etc.; anything that is disposed of and not reused.

Spores — Seeds of fungi.

Survival — The process of obtaining what is necessary for the continuation of life.

Thermal Pollution — Pollution of water by heating which makes an unfavorable environment for animals and plants to live.

BIBLIOGRAPHY

Books for Teachers

Busch, Phyllis S., *The Urban Environment, A Teacher's Guide*, J.G. Ferguson Co., Chicago, 1975.

Collis, Margaret, *Using the Environment, Tackling Problems, 3*, Macdonald Educational, London, 1974.

Ewald, Ellen Buchman, *Recipes for a Small Planet*,Ballantine, NY.

Friendly, Natalie, *Miraculous Web, The Balance of Life*, Prentice-Hall, 1968.

Frisch, Otto Von, *Camouflage in Nature*, Franklin Watts International Library, 1973.

Froman, Robert, *Mushrooms and Molds*, Crowell, NY, 1972.

Hamilton, Charles, *ECO*, Educational Service, Inc., Stevensville, MI, 1974.

Ickis, Marguerite, *The Standard Book of Quilting & Collecting*, Dover, 1949.

Jones, W. Ron, *A Deschool Primer, Your City Has Been Kidnapped*, Addison-Wesley, Menlo Park, CA, 1972.

Lavaroni and O'Donnell, *Air Pollution*, Addison-Wesley, Menlo Park, CA, 1971.

Lavaroni and O'Donnell, *Noise Pollution*, Addison-Wesley, Menlo Park, CA, 1972.

Lavaroni, O'Donnell and Lindberg, *Water Pollution*, Addison-Wesley, Menlo Park, CA, 1971.

Lipschitz, Ceil, *An Ecology Craftsbook for the Open Classroom*, The Center for Applied Research in Education, NY, 1975.

McClung, Robert, *How Animals Hide*, National Geographic Society, Washington, DC.

Nickelsburg, Janet, *Ecology, Habitats, Niches and Food Chains*, Lippincott, NY, 1969.

Parker, Sheila, *Minibeasts*, Macdonald Educational, London, 1974.

Subarsky, Zachariah, *Living Things In Field and Classroom*, University of Minnesota, 1969.

TEACHER'S GUIDES

A Child's Garden, Chevron Chemical Co., Ortho Div., San Francisco, CA, 1974.

Endangered Species, National Wildlife Federation, Washington, DC.

Environment, A Way of Teaching, Alameda County Board of Education, Hayward, CA, 1971.

Essence II, Addison-Wesley, Menlo Park, CA, 1971.

McDonald's Ecology Action Pack, McDonald's Corp., Oak Brook, ILL., 1974.

Outdoor Biological Instructional Strategies (OBIS), Lawrence Hall of Science, University of California, Berkeley, CA, 1975.

Books for Children

Aruego, Jose, Symbiosis, A Book of Unusual Friendships, Scribners Sons, NY, 1970.

Baylor, Byrd, *Everybody Needs a Rock*, Scribners Sons, NY, 1974.

Burton, Maurice, A Golden Introduction to Nature: *The Life of Meat Eaters, The Life of Insects, The Life of Birds*, Golden Press, NY, 1973.

Carle, Eric, *The Tiny Seed*, Crowell, NY, 1970.

Cooper, Elizabeth K., *Science In Your Own Backyard*, Harcourt, Brace & World, Inc., NY, 1958.

Cooper and Ranter, *Many Hands Cooking*, Crowell, NY, 1974.

Farb, Peter, *The Forest*, Time, Inc., 1967.

Foreman, Michael, *Dinosaurs and All That Rubbish*, Crowell, NY, 1973.

Froman, Robert, *Mushrooms and Molds*, Crowell, NY, 1972.

Geisel, T. Seuss, *The Lorax*, Random House, NY, 1971.

McCormick, Jack, *The Life of the Forest*, McGraw-Hill, NY, 1966.

Miles, Betty, *Save the Earth*, Knopf, NY, 1974.

Miles, Miska, *Annie and the old One*, Little Brown, Boston, MA, 1971.

Parnell, Peter, *The Moutain*, Doubleday and Co., NY, 1971.

Pomerantz, Charlotte, *The Day They Parachuted Cats on Borneo*, Young Scott Books, 1971.

Pringle, Lawrence, *Estuaries, Where Rivers Meet the Sea*, MacMillan, NY, 1973.

Schwartz, Julius, *It's Fun To Know Why*, McGraw-Hill, NY, 1973.

Skelsy and Huckaby, *Growing Up Green*, Workman Publishing Co., NY, 1973.

Tressatt, Alvin, *It's Time Now*, Lothrop, 1969.

Wiseman, Ann, *Making Things*, Little Brown and Co., Boston, MA, 1973.

Books For Young Explorers Series: *Pandas; Honeybees; Namu; How Animals Hide*, National Geographic Society, Washington, DC, 1973.

There Lived a Wicked Dragon, US Environmental Protection Agency, 1973.

GENERAL ENVIRONMENTAL EDUCATION BIBLIOGRAPHY

A Beginning, Healy and Root, Sierra Club, SF, 1973 (56 pages)
Although not a definitive survey of what's available, this is an excellent resource book covering literature, curriculum units, texts, general resource material for teachers, periodicals, music/-games, films/filmstrips and a list of conservation organizations. Annotations are detailed and complete and prices and addresses are given for all resources except literature.
To get a copy, send $1 to: Sierra Club Books, 1050 Mills Tower, SF, CA 94104.

Aids To Environmental Education, Preschool — Grade 6, Massachusetts • Audubon Society for the US Office of Education, 1972 (27 pages)
Working from the assumption that environmental education is not a new subject but should be an "umbrella" under which all disciplines can be combined, the Massachusetts Audubon Society has compiled this "select, rather than compreprehensive, listing of materials prepared for the information and convenience of teachers." It is a very complete, well-annotated listing through 1972. It is divided into the following sections: Bibliographies, Books, Books for Teachers — Activity Guides, Books for Teachers — Background Reading, Curriculum Materials, Filmstrips, Graphics Magazines and Newsletters, Publishers and Distributors Addresses.
Children's books are listed in alphabetical order are cross-referenced under other books with related subject matter.